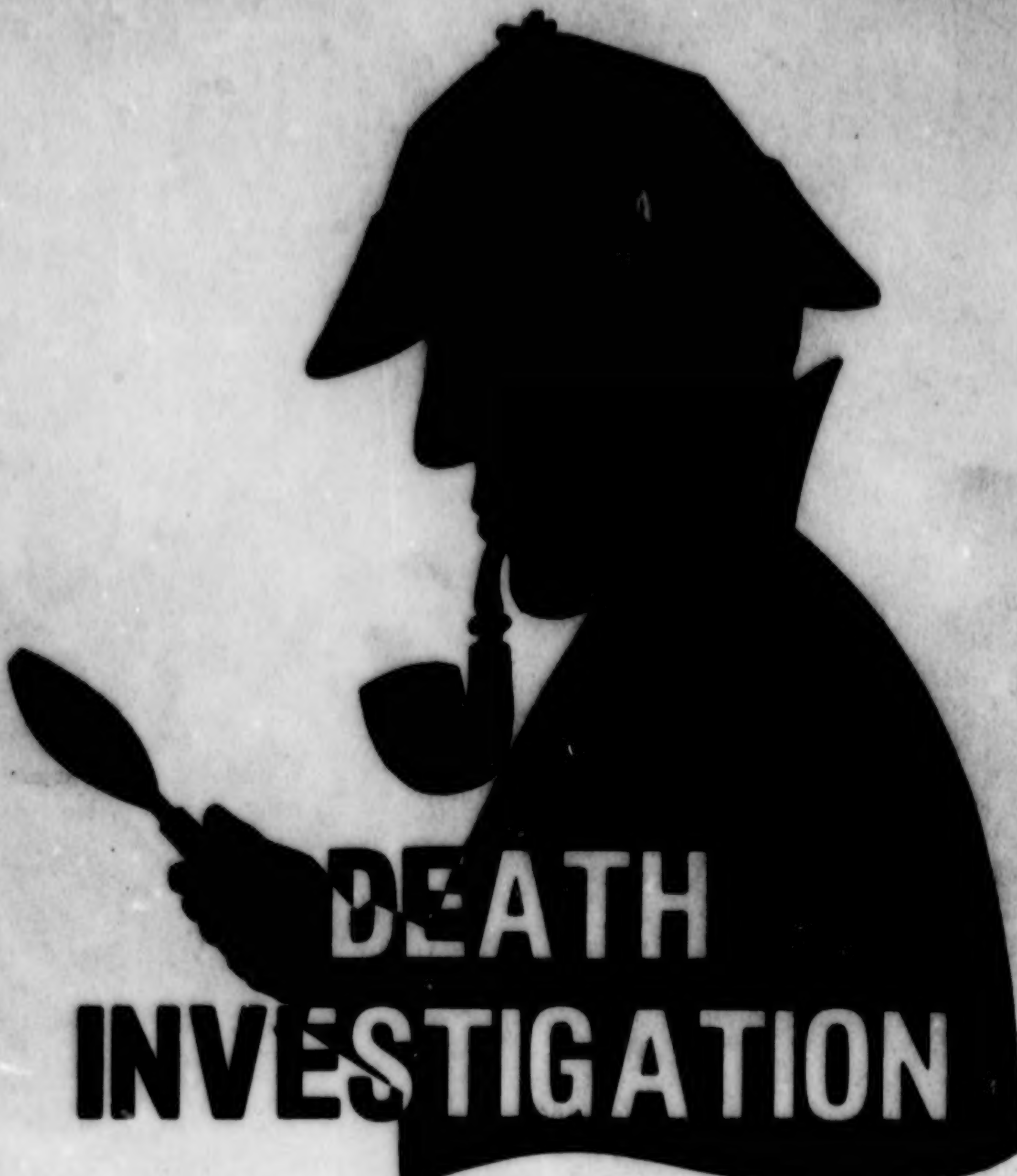
0781-A
806

U.S. Department of Justice
Federal Bureau of Investigation



# DEATH INVESTIGATION

Arthur E. Westveer, Jr., MLA

I

COMPLETED

* * * * *

# DEATH INVESTIGATION

* * * * *

11

## Acknowledgements

Death investigation cannot be thoroughly and professionally conducted without the willing assistance of many individuals. Risking the omission of some, I wish to acknowledge the following professionals whose writings I have included in this compilation:

SA Harold A. Deadman, Laboratory Division FBIHQ; Norman D. Sperberg, DDS. Forensic Odonologist, San Diego County Coroner's Office, San Diego, California; Alphonse Poklis , Ph.D., Director of Toxicology, Medical College of Virginia; James L. Luke, M.D., Former Chief Medical Exminer, District of Columbia; David K. Wiecking, M.D., LL.D.; and Gregory P. Wanger, M.D. Assistant Chief Medical Examiner, Officer of the Chief Medical Examiner, Richmond, Virginia; John G. Ward, Jr., Forensic Scientist, Division of Consolidated Laboratory Services, Bureau of Forensic Science, Commonwealth of Virginia, Norfolk; Brian D. Blackbourne, M.D.; Winston C. Norman, Major Case Specialist, BSISU, FBI Academy, Quantico, Virginia; John E. Smialek M.D., Chief Medical Examiner State of Maryland, SSA Robert Spalding, Laboratory Division, Federal Bureau of Investigation, Washington, D.C., SSA Robert R. Hazelwood, Behavioral Science Instruction and Research Unit, FBI Academy, Quantico, Virginia, SSA John E. Douglas, Behavioral Science Investigative and Support Unit, FBI Academy, Quantico, Virginia.

I would also like to acknowledge and thank the following individuals from the Behavioral Science Instruction and Research Unit, National Center for the Analysis of Violent Crime, who have assisted in and supported the production of this book: SSA John H. Campbell, Unit Chief, SSA Richard L. Ault, Mrs. Cynthia Lent, Research Assistant, and Mrs. Constance O. Dodd, Clerk Typist.

Cover design by Lisa Wisniewski, FBI Academy

* * * * *

## The Homicide Investigator

No greater honor will ever be bestowed on an officer or a more profound duty imposed on him than when he is entrusted with the investigation of the death of a human being.

It is his duty to find the facts, regardless of color or creed, without prejudice, and to let no power on earth deter him from presenting these facts to the court without regard to personality.

Anonymous

* * * * *

# Philosophy of Death Investigation
## In the words of Ramsey Clark - Washington, DC - 1972

It is of the utmost importance to the individual, to society, to truth, justice and safety that we find the facts concerning death.

The search for truth is the essence of forensic pathology. This truth forms an essential link between the enforcement of law and the protection of the public in the administration of justice.

We must have courage, indeed the ardent desire, to know the causes of death. We cannot let the 'corpus delecti' diminish our capacity for joy. We should not faint at death. Death is truth and while all truth may not seem beauty, all truth can strengthen our humanity.

The great and constant need of those who investigate homicide and practice forensic pathology or criminal law is a warm humanism.

For a people who will not face death cannot revere life . . .

Spitz & Fisher, *Medicolegal Investigation of Death,* Foreword, Ramsey Clark, 1973.

* * * * *

# Introduction

The purpose of this publication is to consolidate the training material utilized in the Basic Death Investigation Course and Death Investigation Field Schools conducted by the Behavioral Science Instruction and Research Unit, National Center for the Analysis of Violent Crime, FBI Academy, Quantico, Virginia.

This course takes a holistic approach to investigating the death of a human being. It begins with a brief discussion of the history of the coroner and medical examiners systems to include a forensic autopsy.

In the section on approaching the crime scene, we discuss the effects of a traumatic death scene on the first officer to arrive as well as the investigator assigned to the crime scene. Some investigative aids and techniques are reviewed, using case examples.

Also covered are the following topics:

Post Mortem Changes and Time of Death
Injuries From Edged Weapons and Their Effect on the Body
Blunt Force Injuries and Their Effects on the Body
Blood Spatter Pattern Analysis
Homicide by Poison
Asphyxial Deaths
Fire and Heat-Related Deaths
Firearm Injuries
Substance Abuse Deaths
Autoerotic Fatalities
Suicide
Forensic Pediatrics
Criminal Investigative Analysis
Overview of Drowning

Miscellaneous articles germane and timely to the subject of death investigation are included at the end of this publication.

# Table of Contents

* * * * *

# History of Forensic Science

* * * * *

**BASIC DEATH INVESTIGATION**

**CJ 401**

**HISTORY OF FORENSIC SCIENCE**

By: Arthur E. Westveer
Behavioral Science Services
FBI Academy
Quantico, Virginia

BLANK PAGE

## FORENSIC SCIENCES IN ANTIQUITY

Earliest application of forensic medicine was with the interdiction against suicide.

Suicide regarded as a crime against public interest since before the birth of Christ.

Early primative belief was that suicide victims were possessed by evil spirits.

African tribes burned the hut of the suicide victim and expelled the family from the village.

Greece condemned suicide as an act of rebellion against the Gods.

Socrates, condemned by the community, committed suicide by drinking hemlock.

Medicolegal opinion as to the manner of death had to be reached in such cases, if suicide, the penalty was denial of funeral rites.

Roman soldiers, who committed suicide, were treated as deserters.

In the 10th Century suicide became a crime under common law.

Decisions as to manner of death made by investigation of circumstances without specific exam of body.

Exception - Antistius, a physician in Rome, examined the body of Julius Ceasar. His opinion was that of the 23 stab wounds Ceasar sustained, the only mortal wound was one in the chest.

In China a handbook entitled "Hsi Yuan Lu" was published about 1250. It contained guidelines for the postmortem examination of bodies, including descriptions of various wounds caused by sharp versus blunt instruments. It also deferred comments on the determination of whether an individual found in the water had died of drowning or had been killed before hand, and of whether a burned individual was dead before the onset of the fire.

The early development of the autopsy is forensic pathology in Europe began in 1507 when a volume known as the Bamberg Code appeared 23 years later. A more extensive penal code, known as the Constitution Criminalis Carolina, was issued by Emperor Charles V. The two documents portrayed the importance of forensic pathology in requiring that medical testimony be an integral part of the proof

Did not specify complete autopsy.

Skilled medical knowledge was required of the expert witness.

Andreas Vesalius - first pioneer in anatomy, reported findings in lungs of smothered children. Studied traces left by sexual assault.

Fidelis and Zacchia - Italy, early 17th Century, described the findings in drowned bodies that would distinguish between homicidal and accidental drowning.

Zacchia's work included descriptions of bullet and stab wounds, asphyxial deaths, the distinction of homicide from suicide, and the determination of whether an infant had been born alive.

The first formal lectures in forensic pathology were held by Michaelis and Bohn, University of Peipzic. Students instructed in the subject of violent deaths and simulated material deaths. As a result police in Europe began to call upon physicians to aid in the solution of fatal crimes. However, there was little scene investigation by these physicians. About this time is when the recognition of the medicolegal importance of blood stains first developed.

**BASIC DEATH INVESTIGATION**

**CJ-401**

**Development of the Coroner System and the Medical Examiners System**

By Mr. Arthur E. Westveer
Behavioral Science Services
FBI Academy
Quantico, Virginia

BLANK PAGE

## DEVELOPMENT OF THE CORONER SYSTEM AND THE MEDICAL EXAMINER SYSTEM

Until the Tenth Century, it seemed as though decisions as to the manner of death were made mostly by an investigation of the circumstances without special examination of the body. However, there is an exception. Historians report that Antistius, a physician in Rome, examined the body of Julius Caesar and reached the opinion that, of the 23 wounds Caesar sustained, the only mortal wound was one in the chest.

As early as 1250 in China, a book entitled "Hsi Yuan Lu" (male Chinese name) was published. It contained guidelines for the post-mortem examination of bodies, including descriptions of various wounds caused by sharp versus blunt instruments.

The early development of the autopsy in forensic investigations began about 1507 with the documentation of the development of forensic pathology. This documentation was called "The Bamberg Code."

In 1530, a more extensive penal code known as "The Constitution Criminalis Carolina" was issued by Emperor Charles V for all the lands included in his empire. These two documents outlined the importance of forensic pathology in medical testimony.

For the purposes of this paper, forensic means legal, pertaining to the law; and pathology is the study of the nature and cause of disease or injury which involves changes in structure and function.

Andreas Vesalius, one of the pioneers in anatomy, was dissecting cadavers and established the true facts of the anatomy of the body.

In the late Sixteenth Century, Ambrose Pare performed official medicolegal autopsies.

A medicolegal autopsy is a complete examination of the body, exterior and interior tissue, body fluids, and clothes. This type of autopsy is performed by a forensic pathologist specially trained to determine the manner of death and is quite different from a hospital autopsy which is conducted by a physician and is limited to the area of treatment.

In the early Seventeenth Century, two men in Italy, named Fidelis and Zacchia, were involved in anatomical dissections and reported analysis of injuries to internal organs.

Fidelis described findings in drowned bodies that would distinguish between homicidal and accidental drowning.

Zacchia's work included descriptions of bullet and stab wounds, asphyxial deaths, the difference between suicide and homicide, as well as the difference between sudden deaths and death from natural causes and, in cases of infantcide, the determination of whether an infant had been born alive.

The first formal lectures in forensic pathology were held by Michaelis and Bohn at the University of Leipzig. These lectures dealt with violent deaths.

Because of the work of these people, the police in Europe began to call upon the medical profession to aid in the solution of fatal crimes. It was due to the response of these medical people responding to crime scenes that the medicolegal recognition of the importance of blood stains first developed.

The American medicolegal investigation can be traced back to the English coroner system, which had developed in that country.

The early American colonists, originating in England, brought the coroner system with them. The earliest record of a coroner's inquest was in the Colony of New Plymouth, New England, in 1635. Briefly, the inquiry found that John Deacon died as a result of bodily weakness caused by fasting and extreme cold.

January 29, 1637, Thomas Baldridge was appointed Sheriff and Coroner. As such, he was authorized to "do all and everything the Office of Sheriff and Coroner of any county in England does." Two days later, Baldridge impaneled a jury of twelve men to hold an inquest over the body of one John Bryant. Their verdict was "John Bryant, by the fall of a tree, had his bloud bulke broken; and hath two scratches under his chinne on the left side; and so that by means of a fall of the said tree upon him the said John Bryant came to his death." As both Coroner and Sheriff, Baldridge was responsible for the collection of property taxes, poll taxes, and other levies of which he received ten percent.

Another early definition of the coroner's duties is also recorded in the archives of Maryland indicating that on April 30, 1640, the Governor appointed John Robinson, High Constable, as Coroner of St. Mary's County.

Records show that autopsy examinations of bodies were recorded in Massachusetts as early as 1647.

In Maryland the medicolegal autopsy was applied on March 21, 1665, when Francis Carpenter was brought before the court on suspicion of murdering Samuell Yeoungman, a servant. The coroner's report absolved Mr. Carpenter saying "wee of the jury haveing viewed the corps of Samuell Yeoungman and finding a depression in the cranenum in on (one) place, and another wound

where all the muscle flesh was corrupted, and withall finding corrupt blood betweene the dura and piamater, and the braine and several other bruises in the head and body. Therefore our verdict in that for want of looking after the above said wounds, were the cause of death." No mention is made as to whether Mr. Carpenter inflicted the original wounds on the deceased's head.

The earliest mention of the physician in connection with the work of the coroner was in 1860 in Maryland, where the Code of Public General Laws authorized the coroner or his jury to require the attendance of a physician in cases of violent death. Eight years later the legislature authorized the Governor to appoint a physician as sole coroner of the City of Baltimore.

1877, Boston a state-wide system requiring that the coroner be supplemented by a physician known as the Medical examiner. However, his jurisdiction was limited to dead victims of violent crimes.

In 1890, pathology began to play an important part in death investigations. In Baltimore, a city ordinance authorizing the Board of Health to appoint two physicians with the title of Medical Examiner to perform all autopsies requested by the coroner.

In 1915, New York City eliminated the Coroner's Office and created a Medical Examiner's system, authorizing investigation of deaths resulting from criminal violence, casualties, or suicide, or a sudden death when in apparent good health, or when not attended by a physician.

This was the first civil service appointment involving medicolegal investigation. New York City was the site of the first modern facility to house the medical examiner's office and the Institute of Forensic Medicine which was initiated by Dr. Milton Helpern. Massachusetts had an unusual arrangement in that a medical examiner's system existed but the decision to perform autopsies was made by the District Attorney. This changed in 1945 when the discretion was given to the medical examiner.

The first state-wide medical examiner system was established in Maryland in 1939. This system adopted the New York system of investigating a wide variety of cases and left the decision of performing an autopsy up to the medical examiner.

A number of cities, the District of Columbia, and about 20 states have changed from the coroner system to a medical examiners system. In 21 other states, there are coroners and medical examiners systems in co-existence or legal guidelines requiring anyone conducting a medicolegal investigation to be a physician or have special knowledge or ability in such matters.

The remaining nine states have no requirements and the person responsible for the investigation of death is still the coroner - generally an elected official with no expertise in the field of forensic pathology.

NOTES

BLANK PAGE

## NOTES

BLANK PAGE

* * * * *

# Approaching the Crime Scene

* * * * *

BLANK PAGE

**APPROACHING**

**THE**

**CRIME SCENE**


Arthur E. Westveer
FBI Academy
Quantico, Virginia

1. Introduction

The investigation of death, particularly the homicide crime scene, is without a doubt, the most important investigation a police officer investigator will be called upon to respond to.

There are three basic principles involved in the initiation of an effective death investigation.

A. Rapid Response to the crime scene by patrol officers, the purpose being to protect evidentiary materials before they are destroyed, altered or lost.

B. Evidence. Anything and everything should be considered as evidence. Physical or testimonial evidence must be noted, preserved, and brought to the attention of the investigators.

C. Notification of Investigators. After the scene is secured, immediate and appropriate notification must be made to the homicide investigators.

2. The Crime Scene - Primary

Investigations usually begin where the body is originally found - primary crime scene.

However, there may be two or more crime scenes in addition to where the body was found.

3. Secondary Crime Scenes

A. Where the body was moved from

B. Where the actual assault took place

C. Where the victim died

D. Where any physical or trace evidence is discovered

E. Vehicle used to transport the body

F. Points of forced entry

G. Route of escape

H. The suspect (clothing, hands and body)

4. At The Scene

A. Attitude and emotion must be controlled in order to insure a thorough and professional investigation. Cool - calm - detached.

   Attitude - Evidence will be located if time and effort are expended in a professional and methodical processing of the scene.

B. Emotions - Conscious and subconscious reactions to violence and brutality can effect the investigation to a point that good judgement is transformed into complete confusion.

C. First Officer's Responsibilities at the Scene

   1. Check victim for signs of life and take necessary action.

   2. Apprehend the perpetrator if on the scene - give description, method of escape, etc.

   3. Identify and detain witnesses.

   4. Protect and secure scene.

DOCUMENT

5. Physical Evidence - Any tangible article, large or small, which tends to prove or disprove a point in question.

   "The unimpeachable witness" cannot be eluded by
   faulty memory
   prejudice
   poor eyesight

   Physical evidence

   A. Must be obtained under constitutionally-legal grounds

   B. Collected and preserved properly

   C. Proper chain of custody

   D. Proper tests conducted by proper personnel

Physical evidence obtained

A. Nearest to where critical act occurred

B. Point of forced entry

C. Route of escape and approach

D. Suspect (clothing, body, hair, fluid, etc.)

E. Location of weapon

F. Vehicle used

G. Suspect residence

H. Location of initial assault

I. Location where body was moved from

If it becomes necessary to move or secure something at a crime scene document location, position, and why it was disturbed. Remember, once an item of evidence has been moved or altered it is impossible to restore it to its original position or condition.

6. The Crime scene, especially in homicide cases, is proof that a crime has been committed. It often contains many or all of the elements of the corpus delecti, and provides an abundance of physical evidence that may connect a suspect or suspects to the crime.

Homicide investigations start at the crime scene

Reasons -

A. The police are usually called to this location by the person who discovers the body, a witness to the crime, or sometimes the victim.

B. In homicide cases the location where the body is discovered yields an abundance of physical evidence and serves as a base of inquiry.

C. Close examination of the scene may reveal:

1. The identification of the victim

2. Approximate time of death

3. Other evidence or clues as to the circumstances of the death

Cardinal rule - Protect and preserve the crime scene.

However, before a crime scene can be protected it must be identified as such.

A. Officer must know what constitutes physical evidence.

B. Be able to establish crime scene boundries

7. Examples of Physical Evidence

| Objects | Body Materials | Impressions |
|---|---|---|
| Weapons | Blood | Fingerprints |
| Tools | Semen | Tire tracks |
| Firearms | Hair | Footprints |
| Displaced furniture | Tissue | Palm prints |
| Notes, letters, or papers | Spittle | Tool marks |
| Bullets | Urine | Bullet holes |
| Vehicles | Feces | Newly damaged areas |
| Cigarette/cigar butts | Vomit | Dents and breaks |

The crime scene begins where the suspect changed intent into action and continues through the escape route. This includes any location where physical or trace evidence may be found.

8. The best course of action to determine crime scene boundries.

A. Clear the largest area possible, the scene can be narrowed later.

B. Make a quick, objective evaluation of the scene based on:

1. Location of the body

2. Presence of any physical evidence

3. Eyewitness statements

4. Presence of natural boundries

Keep in mind the possibility of multiple crime scenes.

9. Release of the Scene

A. Hold as long as possible

B. Never before

1. Initial canvass is completed and reviewed

2. <u>All</u> known witnesses interviewed and statements reviewed

3. Suspect processed and statement checked

4. Final check by you and others

10. Canvass

When to be conducted - why

Scope

Personal

Canvass form

A. <u>When</u> - In almost all cases

1. Approximate time of death or assault

2. Use common sense - more than once

B. <u>Why</u> - Eyewitness to crime or suspect

1. Information about the circumstances

2. Approximate time of occurrence

3. Information about deceased

4. Habits

5. Friends

6. Motives

C. <u>Scope</u> - Any place in which scene could be observed or heard

1. Route taken by victim

2. Escape route

3. Tag numbers

D. <u>Personal</u>

1. Must have an interest

2. Should know some of the details of the crime

3. Make a written record of persons contacted

E. <u>Canvass Form</u>

1. Name and assignment of officer

2. Date and time of interview or attempt

3. Name, age, address, home and work telephone number

4. Who else lives there

5. Do you know of incident

6. How - what do you know

7. Heard from who

8. Relationship - last seen or talked to

9. Were you on the crime scene

10. Statement taken

11. Reasons for Note taking

A. Time is frequently the first subject covered in cross examination.

B. Time may be used as an alibi.

C. Note taking forces the investigator to slow down.

12. Investigators Notebook

A. Date and time notified

B. Location

C. How notified - by whom

D. Time of arrival on scene

E. Describe scene from outside

F. Address

G. Who is on the scene

H. Weather conditions

I. Lighting

J. First officer - name assignment

K. Method of receiving assignment

L. Time of arrival on scene

M. Who was on the scene

N. What did they do - touch

O. What did the officer do

P. Condition of scene when officer arrived

Q. Witness statements

R. Opinion of officer

11. Crime Scene Sketch

    A. Refresh memory of investigator

    B. Brief investigators not on scene

    C. Refresh memory of witness(es)

    D. Refresh memory of cooperative suspect in his/her reconstruction of events

    E. Develop a clear understanding of what happened

    F. Develop theory as to what happened through evidence collected

    G. Explain to the prosecutor, judge, jury, witnesses, a clear understanding of the scene, location of evidence, and sequence of events.

12. Crime Scene Sketch Supplement

    A. Aerial photographs

    B. Road maps

    C. Blueprint

    D. Floor plan

    E. Street map

**DEATH INVESTIGATION BULLETIN**

**GLOSSARY OF TERMS AND DEFINITIONS**
**COMMONLY USED IN THE INVESTIGATION OF DEATH**

This bulletin contains most of the terms and definitions commonly used in the various reports associated with death investigations.

Winston C. Norman
Behavioral Science Investigative Support Unit
FBI Academy
Quantico, Virginia
August, 1986

BLANK PAGE

## DEATH INVESTIGATION

## GLOSSARY OF TERMS

| | |
|---|---|
| ABBREVIATIONS USED: | Adj: - Adjective<br>Syn: - Synonym |
| ABDOMEN: | Portion of the body between the thorax (chest cavity) and the pelvic area. |
| ABORTION: | 1. The expulsion of the fetus usually in the first trimester of pregnancy.<br>2. The interruption of pregnancy before the state of fetal viability. |
| ABRADED MARGIN: | Syn: Abrasion ring. A zone of abrasion surrounding the entrance wound of a bullet, caused by the stretching of the skin and the rotational movement of the projectile. |
| ABRASION: | Wearing away of the skin in small shreds by friction. |
| ACID PHOSPHATASE: | A group of enzymes occurring in many cells of the body. The only secretion in which acid phosphatase is found is that of the prostate gland. The finding of acid phosphatase in vaginal washings or on clothing is thus regarded as indicative of the presence of semen. |
| ACUTE: | Sharp, severe or of brief duration. |
| ADHESIONS: | Found following operative intervention where the tissues effected adhere to themselves or a visceral cavity surface. |

**ADIPOCERE:** Syn: Adipocire. A waxy, greyish-white substance consisting largely of free fatty acids, produced in the fatty tissues of the body by the hydrolysis of fats in a moist environment.

**AGONAL:** Adj: Related to the last moments of life or to the death struggle.

**AIR EMBOLISM:** See: Embolism

**ALCOHOL:** A hydroxy derivative of aliphatic hydrocarbons. When used without qualifications, the term denotes ethyl alcohol ($C_2H_5O$). Syn: ethanol, grain alcohol, the active ingredient of alcoholic beverages. Alcohols are central nervous system depressants.

- **METHYL ALCOHOL:** Syn: Methanol, wood alcohol ($CH_3OH$). A common industrial solvent and constituent of resins and varnishes. It is much more toxic than ethyl alcohol.

**AMNESIA:** Lack or loss of memory, especially in remembering past experiences.

**AMPHETAMINES:** Syn: "Speed." A group of drugs including amphetamine sulfate, methylamphetamine and dextroamphetamine. The amphetamines are central nervous system stimulants which in therapeutic doses cause elevation of mood, alertness, increase in mental ability and reduction of appetite. In toxic doses, they cause restlessness, irritability, hallucinations and panic states. Cerebral hemorrhage may be a terminal event.

**ANALGESIC:** A drug which relieves pain.

ANAPHYLAXIS: An acute and sometimes fatal reaction within seconds or minutes after exposure to an allergen to which an individual is hypersensitive.

ANATOMY: Study of the structure of the human body.

ANEMIA: Insufficient oxygen-carrying capacity of the blood.

ANEURYSM: A localized bulging of a blood vessel or chamber of the heart arising from a weakness of its wall.

- ARTERIO-VENOUS: An aneurysm involving a direct communication between an artery and a vein. Arterio-venous aneurysms may be congenital in origin or be caused by an injury.

- BERRY (SACCULAR): Syn: Congenital aneurysm. An aneurysm involving one of the arteries at the base of the brain. Rupture of a berry aneurysm is a common cause of sudden death in young or middle-aged adults.

- MYCOTIC: An aneurysm arising in a weakness of a blood vessel wall caused by infection.

- TRAUMATIC: An aneurysm arising in a weakness of a blood vessel caused by injury.

ANGINA: Spasmodic pain.

ANGINA PECTORIS: Spasmodic pain in chest caused by sudden decrease of blood supply to the heart muscle.

ANOXIA: Lack of oxygen.

ANTEMORTEM: Adj. Premortem: present or occurring before death.

ANTERIOR: Adj: Ventral: before, in front of, facing toward the front.

| | |
|---|---|
| **ANTIDOTE:** | The remedy for counteracting a poison. |
| **ANUS:** | The distal end and outlet of the alimentary canal. |
| **AORTA:** | The main artery arising from the heart and giving rise to the entire systemic arterial system. |
| **ARACHNOID:** | The middle membrane covering the brain and spinal cord. |
| **AREOLA:** | The pigmented ring around the nipple of the breast. |
| **ARTIFACT:** | A change brought about artificially and not by natural or traumatic processes. |
| **ARTERIOSCLEROSIS:** | A group of pathological conditions affecting arteries and resulting in hardening, thickening, loss of elasticity of the wall, and often in narrowing of the lumen. |
| **ARTERY:** | A blood vessel carrying blood on its way from the heart to the tissues of the body. |
| - CORONARY ARTERIES: | The two main arteries and their tributaries arising from the aorta and supplying blood to the heart muscle. |
| **ASPHYXIA:** | Death caused by lack of oxygen or by the inability of the tissues to utilize oxygen. |
| - CHEMICAL: | Asphyxia produced by a chemical agent which prevents the combination of hemoglobin and oxygen (e.g., carbon monoxide), or the release of oxygen from hemoglobin (e.g., cyanide). |
| - TRAUMATIC: | Asphyxia caused by compression of the chest and prevention of respiratory movements. |

**ASPIRATION:** Breathing or drawing in of a substance into the respiratory tract, blocking same.

**AUTOEROTICISM:** Sexual arousal and/or gratification without a partner.

**AUTOLYSIS:** The dissolution of cells and tissues by enzymes normally present in them. Autolysis is the earliest morphological postmortem change and is the predominant change in sterile cadavers such as newborn infants. It is also the main mechanism in the dissolution of infarcts.

**AUTOPSY:** Syn: Necropsy, postmortem. A dissection of the body after death to determine the cause of death and to study the changes in the tissues caused by disease or violence. The term is often used to include any subsequent examination, including microscopic or chemical.

- **PSYCHOLOGICAL:** A review of investigative findings and the performance and evaluation of a series of structured interviews conducted by a psychiatrist or trained psychologist with close friends, acquaintances, and relatives of a deceased person in order to determine his psychological make-up during life. This information may be of assistance in determining factors related to the death.

- **SOCIOLOGICAL:** A review of related sociologic and demographic considerations of a deceased person in an attempt to correlate these with the circumstances of death and thereby identify social conditions common to several or many deaths in the expectancy of identifying common etiologic or mitigating conditions.

| | |
|---|---|
| AVULSION: | A tearing away of part of a tissue. |
| BARBITURATES: | Syn: "Barbs," "candy," "goof balls," "peanuts." A group of drugs used as sedatives, hypnotics and anesthetics. They include thiopental (ultrashort-acting), pentobarbital and secobarbital (short-acting), amobarbital (intermediate) and phenobarbital (long-acting). |
| BAROTRAUMA: | Injuries, such as rupture of the eardrum, caused by sudden changes in atmospheric pressure. |
| BATTERED CHILD SYNDROME: | See: Syndrome. |
| BENZEDRINE: | Brand of amphetamine sulfate (Smith, Kline and French Laboratories). Benzedrine tablets syn: "bennies," "hearts," "peaches," "roses." |
| BERRY ANEURYSM: | See: Aneurysm. |
| BIRTH INJURY: | Syn: Birth trauma. An injury to the infant sustained during birth. Common birth injuries include fractures of the skull, rupture of the dural venous sinuses, brain damage, stretching of nerves and dislocation of joints. |
| BLISTER: | Syn: Bulla, vesicle. An elevation of the superficial layer of the skin or mucous membrane containing fluid. When small, often called a vesicle or bleb; when large, a bulla. Blisters may be antemortem or postmortem in origin. |
| BLOOD GROUPS: | Individuals who have the same type of blood with regard to the two major red cell antigens A and B. Persons having antigen A only are said to be blood group A; those possessing antigen B only, |

| | |
|---|---|
| BLOOD GROUPS, CONTINUED: | blood group B; those having both antigens, blood group AB; and those having neither antigen, blood group O. Also includes other groups such as M,N,S, etc. |
| BRUISE: | See: Contusion. |
| BRUSH BURN: | See: Abrasion. |
| BURKING: | A homicidal form of traumatic asphyxia employed by Burke and Hare in which one of the assailants sat on the chest of an intoxicated victim. |
| BURN: | An injury caused by dry heat. |
| CADAVER: | A dead body, a corpse. |
| CADAVERIC SPASM: | Stiffening and rigidity of a single group of muscles occurring during or immediately after death. The existence of this entity is debated. |
| CAFE CORONARY: | Asphyxia due to the impaction of a bolus of food in the larynx or trachea. |
| CAISSON DISEASE: | Syn: Decompression sickness, "the bends." A form of gas embolism seen in divers, tunnel workers, etc. who are being brought quickly from an environment of high atmospheric pressure to one of lower pressure. It is due to the release of bubbles of nitrogen from the blood. |
| CALLIPHORA VOMITORIA: | Syn: Blow fly, blue bottle fly. A common fly which deposits its eggs on recently dead bodies and the larvae of which play an important part in the disintegration of the tissues. |

CALLUS: The tissue which gradually connects the fragments of a broken bone. Callus at first consists of fibrous tissue which is later converted into bone. The microscopic and X-ray appearance of a callus is roughly indicative of its age and thus may often be of importance in cases of suspected battered child syndrome.

CARBON DIOXIDE: A heavy, colorless gas. Carbon dioxide forms in tissues and is eliminated by the lungs.

CARBON MONOXIDE: A toxic gas produced by the incomplete combustion of organic materials. It combines with hemoglobin thus preventing the carriage of oxygen and producing a state of asphyxia. Carbon monoxide is an important constituent of motor exhaust and coal gas.

CARCINOMA: Cancer. This will usually be defined by the portion of the organ or body affected.

CARDIAC TAMPONADE: Compression of the heart by the rapid accumulation of fluid in the pericardial sac. Cardiac tamponade is usually caused by bleeding into the pericardial cavity due to rupture of the heart or one of the coronary arteries.

CARDIOMYOPATHY: A primary disease of the heart muscle.

CARDIOVASCULAR: Pertaining to the heart and blood vessels.

CARNAL KNOWLEDGE: (STATUTORY RAPE) Sexual intercourse with an individual below the legal age of consent.

CAROTID: Arteries of the neck.

CARTILAGE: The gristle or white elastic substance attached to articular bone surface and forming certain parts of the skeleton.

CELLULAR DEATH: See: Death.

CEREBROSPINAL FLUID: "CSF." The clear fluid which is secreted by the choroid plexuses in the brain and which circulated through the ventricular system of the brain and the subarachnoid space.

CEREBRO-VASCULAR ACCIDENT: "CVA." A stroke, severe injury to the brain resulting from spontaneous hemorrhage or thrombosis.

CERVICAL: Pertaining to the neck.

CERVIX: Syn: Cervix uteri. The neck of the uterus connecting the uterine cavity with the vagina and consisting of the external os and internal os.

CHOKING: Asphyxia caused by the mechanical occlusion of the upper respiratory passages, e.g., by a bolus of food.

CHRONIC: Sickness of long duration.

CIRRHOSIS: A chronic disease of the liver with scarring and reduced function most frequently associated with alcoholism but also may follow hepatitis and other more rare diseases.

CLAVICLE: Collarbone.

CLITORIS: An erectile structure, one of the female genital organs located beneath the anterior commisure of the labia minora.

CLOT: A soft, semi-solid coagulum formed in stagnant or postmortem blood, its structure being large determined by gravity. It thus differs from a thrombus.

| | |
|---|---|
| - CHICKEN FAT THROMBUS: | A bright yellow layer, consisting predominantly of white blood cells, and forming the uppermost part of a clot. The position of the chicken fat clot has been used in attempts to determine the position of the body after death. |
| - CURRANT JELLY CLOT: | A dark red layer, consisting of predominantly red blood cells and forming the lower part of a clot. |
| - POSTMORTEM CLOT: | A clot formed in the blood vessels, chambers of the heart or sites of hemorrhage after death. |
| CLOTTING: | See: Coagulation. |
| COAGULATION: | Syn: Clotting. The transformation from a liquid state to a solid or semi-solid mass. Usually applied to the formation of fibrin in blood resulting in a clot or thrombus. |
| COCAINE: | Syn: "Bernice," "candy," "coke," "corine," "dust," "flake," "gold dust," "snow," "stardust." An alkaloid from the leaves of the Erythroxylon trees native to Peru and Bolivia. Systemically, cocaine is a cerebral stimulant; topically, a local anesthetic. Used illicitly, it is usually sniffed in the form of a white powder. |
| CODEINE: | One of the alkaloids of opium. its analgesic effect is weaker than that of morphine, but is a better suppressant of the cough reflex. |
| COLON: | That part of the large intestine which extends from the cecum to the rectum. |
| COMA: | A state of deep unconsciousness from which a person cannot be aroused. Causes of coma include poisonings, brain injuries, stroke, diabetes mellitus and uremia. |

| | |
|---|---|
| COMATOSE: | Unconsciousness. No response to any stimuli. NOTE: the person is <u>not</u> dead. |
| COMMINUTED FRACTURE: | A break of a bone into small fragments. |
| CONCUSSION: | A diffuse injury to an organ caused by a violent impact. Usually applied to the brain (commotio cerebri). |
| CONGENITAL: | Existing at or dating from birth. |
| CONJUNCTIVA: | Delicate membrane lining of the eyelid. |
| CONTACT FLATTENING: | The flattening of muscles which are in contact with a hard surface during rigor mortis. |
| CONTRE COUP: | An injury of an organ occurring on the side opposite to that suffering a blow or impact, resulting from impact of the organ on the interior of the body wall. The term is usually applied to the brain but other organs such as the lungs may suffer contre coup injuries. |
| CONTUSION: | An injury without laceration to the superficial tissues of an organ or the body surface; caused by a blunt impact resulting in a hemorrhage into the tissue beneath the skin. Contusions are usually caused by violence but may be spontaneous in certain blood disorders. During life, the color of contusions changes gradually from red to green to yellow, giving a rough indication of their age. Contusions sustained shortly prior to death may at first show no discoloration of the skin surface but may become more noticeable after the blood in the capillaries has settled to another part of the body. |

CONVULSION: A violent, involuntary contraction or series of contractions of the voluntary muscles.

CORONAL: Adj. In the transverse direction.

CORONAL PLANE: An imaginary plane bisecting the body from side to side at right angles to the sagittal plane. This term is useful in describing gunshot wounds.

CORONARY: A term applied to vessels, nerves, ligaments of the heart.

CORONARY THROMBOSIS: Occlusion of one of the coronary arteries by a thrombus. One of the causes of a "heart attack."

CORONER: An official appointed or elected to investigate certain types of fatalities and to preside over inquests. He/she may or may not be a physician.

CRANIAL SUTURES: The fibrous lines of union between the bones of the cranium. The gradual disappearance of the cranial sutures is one of the anatomical features upon which an estimate of the age of skeletal remains may be based.

CRANIOTOMY: To operate on the head. Brain surgery.

CRANIUM: That part of the skull which encloses the brain.

CRIB DEATH: See: Sudden Infant Death Syndrome.

CRICOID CARTILAGE: The lowermost cartilage of the larynx.

CUT: Syn: Incised wound, slash, slice. A wound caused by a sharp object, usually metal or glass. The wound is longer than deep and tends to gape. Its edges are usually not contused, distinguishing it from a laceration.

CUTANEOUS: Pertaining to the skin.

CUTIS ANSERINA: Syn: Goose flesh, goose pimples. A roughening of the skin caused by the contraction of the erector muscles of the hairs. In the living person, it is caused by fear or exposure to cold. In the cadaver, it is a manifestation of rigor mortis. The presence of cutis anserina in a body recovered from water was at one time regarded as indicating that death had occurred in water. This view is no longer held.

CYANOSIS: A bluish or greyish discoloration of the skin and mucous membranes due to the circulation of insufficiently oxygenated blood.

DEATH: The permanent cessation of all vital functions.

- CELLULAR DEATH: The permanent loss by the cell of its functional integrity. The earliest manifestation of molecular death appears to be an irreversible change in the selective permeability of the cell membrane.

- SOMATIC DEATH: Syn: Clinical death. The permanent cessation of respiration and circulation. Absence of response to external stimuli, of spontaneous muscular movements and lack of brain function as determined by the electroencephalogram have

| | |
|---|---|
| - SOMATIC DEATH: (CONTINUED) | recently been added to the criteria on which the definition of somatic death marks the the extinction of the biological and legal personality. |
| DECIDUOUS TEETH: | Syn: Milk teeth. The first dentition of the child consisting of 20 teeth. |
| DECOMPOSITION: | The separation of compound bodies into their constituent principles - postmortem degeneration of the body. |
| DEFENSE WOUND: | See: Wound. |
| DELIRIUM: | A state of mental disorientation, usually temporary. |
| DELUSION: | A false belief, contrary to reality, which cannot be corrected by reasoning. |
| DEMENTIA: | An irreversible mental deterioration, the end result of many intoxications or neurological disorders. |
| DETERIORATE: | To become worse - impairment. |
| DEXEDRINE: | Brand of dextroamphetamine sulfate (Smith, Kline and French Laboratories). Dexedrine tablets, syn: "dexies," "hearts," "oranges." |
| DIACETYL MORPHINE: | See: Heroin. |
| DIAPHRAGM: | The musculomembranous partition that separates the abdomen from the thorax. |
| DILATATION AND CURETTAGE: | Syn: D and C. A surgical operation consisting of the dilatation of the cervical canal and the scraping of the lining of the uterine cavity. |

| | |
|---|---|
| DIPTERA: | An order of insects consisting of the true flies, most possessing a single pair of wings. The order includes the species Calliphora vomitoria which infests recently dead bodies and the larvae of which feed upon the tissues. |
| DISARTICULATION: | Amputation or separation at a joint. |
| DISEASE: | Any departure from a state of health; illness or sickness. |
| DISINTERMENT: | Syn: Exhumation. The recovery of a body from the earth. Usually applied to the removal of a body from a gave for the purpose of medical examination or transportation to another burial site. |
| DISTAL: | Adj: Further from the trunk or from the origin. |
| DORSAL: | See: Posterior. |
| DROWNING: | Death due to the immersion of the nose and mouth in water or other fluid. Until recently, drowning was regarded as purely asphyxial in nature; however, it is said that only 10-12 per cent of drownings involve true asphyxia. The vast majority of cases are associated with the inhalation of large quantities of water which causes some degree of anoxia as well as acute disturbance in the electrolyte balance of the blood. |
| - DRY DROWNING: | Asphyxia believed to be caused by laryngeal spasm due to the aspiration of small quantities of fluid, or by vagal response to immersion, resulting in cardiac standstill. |
| - WET DROWNING: | Drowning following which large amounts of fluid are found in the lungs. |

**DURA MATER:** The outer and strongest of the three membranes surrounding the brain.

**ECCHYMOSIS:** An extravasation of blood into the skin, mucous or serous membrane. An ecchymosis is larger than a petechial hemorrhage.

**EDEMA:** The presence of excess fluid in the tissue. Edema may be localized as in an area of inflammation or may involve the entire body.

**ELECTROCUTION:** Death caused by the passage of an electrical current through the body. The usual mechanism of death is ventricular fibrillation or paralysis of the respiratory center.

**EMBALMING:** A method of preserving the cadaver by preventing putrefaction. Embalming usually involves the perfusion of the vascular system with a fixative fluid into the serous cavities by means of a trochar. Various dyes such as eosin may be added to the perfusion fluid.

**EMBOLISM:** The plugging of a blood vessel by an embolus. When used without qualification, the embolus consists of a thrombus.

**- AIR EMBOLISM:** Occlusion of blood vessels by bubbles of air which may be introduced into the blood stream by positive pressure as in cases of criminal abortion, by negative pressure of stab wounds of the neck. Air embolism must be distinguished from the presence of gas due to putrefaction.

- BONE MARROW EMBOLISM: Occlusion of blood vessels by fragments of bone marrow. It may follow extensive fractures or orthopedic operations.

- FAT EMBOLISM: Occlusion of capillary blood vessels by fat droplets. It is most commonly seen in the vessels of the brain, lungs and kidneys and follows fractures or contusions of adipose tissue.

- GAS EMBOLISM: Embolism by an insoluble gas as may be seen in caisson disease.

- PULMONARY EMBOLISM: Occlusion of the pulmonary artery or its main branches usually by a thromboembolus. A common cause of sudden death.

- TALC EMBOLISM: Embolism by particles of talc in the circulation. It may lead to the formation of small granulomata in the lungs. See: Junkie's lung.

EMBOLUS: A mass of undissolved matter which travels through the blood stream and may plug a vessel which is too narrow to permit passage.

EMBRYO: Syn: Conceptus. The developing child in the uterus during the first trimester of pregnancy.

EPIDERMIS: The outermost layer of the skin.

EPIGLOTTIS: A leaf-shaped structure situated at the root of the tongue protecting the opening of the larynx during swallowing.

EPIGLOTTITIS: An inflammation of the epiglottis usually caused by Hemophilus influenza. A cause of rapid death in young children.

| | |
|---|---|
| EPILEPSY: | A group of disorders marked by episodic impairment or loss of consciousness and, frequently, convulsions. |
| EPIPHYSEAL INJURY: | Dislocation of the epiphysis of a bone often caused by forceful pulling of an extremity. A common type of injury in the battered child syndrome. |
| EPIPHYSIS: | A part of a bone which is separated from the main part during the period of active growth by a layer of cartilage and which fuses with the main part during adolescence and early adult life. |
| EXHUMATION: | See: Disinterment. |
| EXSANGUINATION: | Death due to loss of blood from the circulatory system. |
| FALLOPIAN TUBES: | Syn: Oviducts, uterine tubes. A pair of muscular tubes connecting the region of the ovaries to the cavity of the uterus. |
| FAT EMBOLISM: | See: Embolism. |
| FATTY METAMORPHOSIS OF THE LIVER: | Fatty liver, a change in the liver following excessive alcohol ingestion and poor diet. |
| FECES: | Bodily waste discharged through the anus. |
| FEMUR: | The thigh bone. |
| FETISHISM: | Association of lust with items of certain portions of the female body or with certain articles of female attire. |
| FETUS: | Syn: Conceptus. The developing child in the uterus during the second and third trimesters of pregnancy. |
| FIBRILLATION: | Fluttering of the heart. Not controlled by motor nerve. |

| | |
|---|---|
| FIBULA: | The outer and smaller bone of the leg, below the knee. |
| FLAIL CHEST: | A chest having lost stability as a result of multiple rib fractures. The loose rib fragments interfere with the inspiriatory expansion of the lungs. |
| FONTANELLE: | A soft spot between the cranial bones of a fetus or infant. Normally, the newborn has two fontanelles: the anterior which is located between the frontal and parietal bones and which closes at the age of about 18 months and the posterior which is located between the parietal and occipital bones and closes at about six weeks. |
| FORENSIC: | Adj: Applied to the law. |
| - FORENSIC MEDICINE: | Syn: Legal medicine. Those parts of medical knowledge which are applied to legal problems. |
| FRACTURE: | A break in the bone. |
| - BUMPER FRACTURE: | A fracture of one or both legs below the knee caused by the bumper of a motor vehicle. It is usually a compound fracture. |
| - COMMINUTED FRACTURE: | A fracture having several fragments due to splintering of the bone. |
| - COMPOUND FRACTURE: | A fracture communicating with the outside through a wound. |
| FRATRICIDE: | The act of killing one's brother or sister. |
| GANGRENE: | The death of an extremity or portion of an organ in the living organism. |
| GARROTTING: | Asphyxia caused by the twisting of a ligature around the neck. |

| | |
|---|---|
| GASTRIC: | Relating to the stomach. |
| GESTATION: | The period of intrauterine development. |
| GRAZE: | An abrasion of the skin caused by contact with a rough surface. The direction of the graze may be indicated by a sharply demarcated beginning and tags of epidermis at the end. |
| GROSS: | As perceived by the naked eye. |
| HALLUCINATION: | A false perception, auditory, olfactory or visual which has no basis in fact. |
| HANGING: | A type of ligature strangulation in which the constricting force is due to gravity. |
| HASHISH: | Syn: "Hash." The resinous juice of the flowering tops and upper leaves of the female hemp plant, cannabis sativa, sold in the form of cakes or blocks. Usually smoked in a pipe. Due to its high content of cannabinols, it is more potent than marijuana. |
| HEAT EXHAUSTION: | A state of collapse following exposure to high temperatures caused by depletion of the body's electrolytes and fluids. Clinically, it resembles shock. |
| HEAT STROKE: | A state of collapse following exposure to high temperatures. It is caused by injury to the body's heat regulating mechanisms. |
| HEMATOMA: | A collection of blood in the tissues resulting from hemorrhage. |
| HEMOPERITONEUM: | The presence of blood in the abdominal cavity. |

| | |
|---|---|
| HEMOPHILIA: | Blood is slow clotting or does not clot, allowing a person to bleed to death. |
| HEMORRHAGE: | The escape of blood from a blood vessel. |
| HEMOTHORAX: | The presence of blood in the chest cavity. |
| HEROIN: | Syn: "H," "Harry," "horse," "joy powder," "scat," "schmeck," "smack," "shit." Diacetyl morphine. A semi-synthetic made by the acetylation of morphine. Not legally available in the United States, Canada or Great Britain. Sold illicitly as a white powder usually heavily adulterated with lactose or quinine. Usually injected intravenously but may be smoked or snuffed. |
| HISTOTOXIC: | Poisonous to tissue or tissues. |
| HOMOSEXUAL: | Syn: "Fag," "fairy," "fruit," "queen," "queer." An individual sexually attracted to members of the same sex. When used without qualifications, indicates a male homosexual. |
| HORIZONTAL PLANE: | An imaginary plane traversing the erect body parallel with the level ground. Useful in describing gunshot wounds. |
| HUMERUS: | Large bone in upper arm above elbow. |
| HYMEN: | Syn: Maidenhead. A membrane which partially occludes the external opening of the vagina. |
| HYOID BONE: | A U-shaped bone in the neck above the larynx. From its central body projects the greater and lesser cornua. The latter are frequently found broken in cases of manual strangulation. |
| HYPERTENSION: | High blood pressure. |

| | |
|---|---|
| HYPNOTIC: | A drug which produces sleep. |
| HYPOSTASIS: | The settling of blood after death into the dependent parts of the body. In the skin, this is manifested by lividity. In the internal organs, congestion is due to hypostasis. |
| HYPOTHERMIA: | A state of abnormally low body temperature, usually below 95° F. |
| HYPOXIA: | Lack of sufficient oxygen. |
| IDIOSYNCRASY: | An unusual or individual reaction, usually to a drug. |
| INCEST: | Sexual intercourse between closely related individuals. |
| INCISION: | A wound inflicted by an instrument with a sharp cutting edge. |
| INFANTICIDE: | The killing of an infant. |
| INFARCT: | The death of a portion of an organ in the living organism due to sudden occlusion of its blood supply. |
| INHALATION: | The drawing of air or other vapor into the lungs. |
| INSTAR: | A stage in the development of an insect larva. |
| INTESTINE: | The membranous tube that extends from the stomach to the anus. |
| INTRA: | Prefix meaning within. |
| ISCHEMIA: | A state of inadequate blood supply to an organ or tissue. |
| JAUNDICE: | Yellow pigmentation of skin most commonly resulting from liver failure. |

JUNKIE'S LUNG: Lungs showing microscopic granulomata caused by the intravenous injection of insoluble materials such as talc or starch granules. Seen in drug addicts. Sudden death due to cor pulmonale has been recorded.

LACERATION: Syn: Split, tear. A wound caused by crushing or tearing of the tissues, usually showing a break in the surface.

LAPAROTOMY: An operation in which the abdominal cavity is opened.

LARVA: Syn: Maggot. A stage of metamorphosis of certain insects between the egg and the pupa. The larva may molt several times, each stage being known as an instar.

LARYNX: Syn: Voice box. A hollow muscular and cartilaginous structure lined with mucous membrane situated between the hyoid bone and the trachea. Its components include the epiglottis, thyroid, cartilage and cricoid cartilages. It contains the vocal cords.

LATERAL: Adj: Away from the midline, towards the side.

LESBIAN: A female homosexual.

LESION: Any abnormal change in the structure of a tissue.

LIGAMENT: Any fibrous, tough band which connects bones or supports viscera.

LIVER: The largest glandular organ situated in the upper part of the abdomen on the right side, usually of a dark red.

| | |
|---|---|
| LIVIDITY: | Syn: Livor mortis. A dark red or bluish-red discoloration of the dependent portions of the external surface of the body due to postmortem stasis of blood. |
| - CONGESTION: | Lividity caused by the distention of skin capillaries by blood. |
| - DIFFUSION: | Lividity partly due to hemoglobin staining of the dependent portions of the skin. Diffusion lividity tends to be "fixed" in contrast to congestion lividity. |
| LSD: | Syn: "Acid." Lysergic acid diethylamide. A hallucinogenic alkaloid occurring in morning glory seeds. Now usually produced synthetically. |
| LUMBAR: | Pertaining to or near the lower region of the back. |
| MANDIBLE: | Lower jaw bone. |
| MANSLAUGHTER: | A legal category of homicide, a lesser offense than murder. |
| MARBLING: | The appearance of vascular patterns on the skin after death. |
| MARGINAL ABRASION: | See: Abraded margin. |
| MARIJUANA: | The flowering tops and upper leaves of the female hemp plant (Cannabis sativa), usually sold as a coarse powder and smoked in the form of a hand-rolled cigarette. Its pharmacological activity is believed to be due to tetrahydrocannabinol. |
| MASOCHISM: | Pleasure derived from physical or psychologic pain inflicted either by oneself or by others. |
| MAXILLA: | Upper jaw bone. |

| | |
|---|---|
| MECONIUM: | The feces of the newborn. The presence of meconium in the anmiotic fluid is indicative of fetal distress. The absence of meconium in a normal intestine of a newborn is strong evidence of a live birth. |
| MEDIAL: | Adj: Toward the midline. |
| MEDICAL EXAMINER: | A physician who, by statute, investigates certain types of fatalities by conducting such examinations as are considered necessary. |
| MEDICAL JURISPRUDENCE: | Those parts of the law which apply to the practice of medicine. |
| MEMBRANE: | A thin layer of tissue which covers a surface or divides a space or organ. |
| MENINGITIS: | An inflammation of the membranes surrounding the brain and spinal cord. |
| MESCALINE: | A hallucinogenic drug derived from the peyote cactus. |
| MESENTERY: | Tissue connecting the intestine to the posterior abdominal wall. |
| METAPHYSES: | Growing portion of bone. |
| METHADONE: | A synthetic analgesic drug similar in its effects to morphine and used as a substitute drug in the treatment of narcotic addiction. |
| MIDLINE: | The center of the head, chest and abdomen. |
| MISCARRIAGE: | The expulsion of the fetus, usually in the second trimester of pregnancy. See: Abortion. |
| MORIBUND: | In a dying condition, dying. |

| | |
|---|---|
| MORPHINE: | A vegetable alkaloid, the principal constituent of opium. Morphine is a powerful analgesic and nervous system depressant with addicting properties. |
| MUMMIFICATION: | The drying of a dead body or parts thereof to a brown, leathery, parchment-like condition on exposure to a warm and dry environment. |
| MYOCARDIAL INFARCTION: | An area of death in heart tissue, usually resulting from coronary thrombosis. |
| MYOCARDITIS: | An inflammation of the heart muscle caused by bacteria, viruses, parasites or hypersensitivity. |
| MYOCARDIUM: | The heart muscle. |
| NARCOTIC: | A drug producing stupor, sleep and relief of pain. |
| NATAL: | Pertaining to birth. |
| NAUSEA: | Tendency to vomit; sickness at the stomach. |
| NECROPHILIA: | Sexual attraction to or interest in dead bodies. |
| NECROSIS: | The death of cells in the living organism. |
| NEMBUTAL: | A brand of pentobarbital (Abbot Laboratories). Nembutal capsules, syn: "nimbys," "yellow jackets." |
| NON COMPOS MENTIS: | Not of sound mind, insane. |
| OCCIPUT: | The back of the head or the skull. |

ODONTOLOGY: Syn: Dentistry. The knowledge of the development, structure and function of the teeth as well as of the pathological processes involving them. The forensic application of odontology are largely concerned with the identification of individuals.

OPIUM: Syn: "Hop," "mud," "tar." The juice of the unripe seed capsules of the poppy plant (Papaver somniferum). The milky juice is dried and the crude opium is sold as a dark brown gummy substance. Its pharmacological activity is due to a number of alkaloids including morphine and codeine. Crude opium is usually smoked in pipes.

ORBIT: Eye socket.

OSSIFICATION: The transformation of cartilage or fibrous tissue into bone.

- CENTERS OF OSSIFICATION: Points of ossification, an early stage in the development of the skeleton. The presence of certain centers of ossification is an indication of the age of an individual.

OSTEITIS: Inflammation of a bone.

OSTEOLOGY: The knowledge of the development, structure and function of bones.

OVARY: The female sex gland which secretes sex hormones and in which the ovum develops.

OVERLAYING: The accidental smothering of a young child in bed by a sleeping adult. Overlaying was formerly regarded as a common event. It is now regarded as rare.

OVUM: The egg or female reproductive cell which after fertilization develops into the embryo.

| | |
|---|---|
| PANCREAS: | A large elongated gland behind the stomach. |
| PARALYSIS: | The loss of the power of voluntary motion. |
| PARANOIA: | Mental disorder characterized by the development of ambitions or suspicions into delusions of persecution. |
| PATELLA: | Knee cap. |
| PATHOLOGY: | Syn: Pathologic anatomy. That branch of medicine concerned with the alterations in the structure and function of tissues caused by disease or violence. The practice of pathology includes the performance of autopsies. |
| PEDERASTY: | Homosexual anal intercourse with boys. |
| PEDOPHILIA: | Sexual activity of adults with children. It may involve any form of heterosexual or homosexal activity. |
| PERITONEUM: | A serous membrane which lines the internal surface of the abdominal walls and envelops the abdominal organs. |
| PERITONITIS: | An inflammation of the peritoneum. |
| PERMEATION: | The spreading through a tissue or organ of a disease process. |
| PETECHIAE: | Syn: Petechial hemorrhage. Tiny hemorrhages in the skin, mucous membrane or serous surfaces. |
| PHALANX: | Any one of the small bones of the fingers and toes. |
| PHOSPHATASE: | See: Acid phosphatase. |

PLACENTA: Syn: Afterbirth. A round, flat organ at the site of implantation containing maternal blood vessels and through which the fetus receives oxygen and nourishment. The finding of placental tissue in the uterus is absolute proof of pregnancy.

PLEURITIS: "Pleurisy," inflammation in the chest cavity.

PNEUMONIA: Inflammation in the lung.

POSTERIOR: Adj: Dorsal, to the rear, behind, or facing backwards.

POSTMORTEM: Adj: Occurring after death.

- INTERVAL: The time between death an the examination of the body.

- CHANGES: A number of physical and chemical changes which commence immediately after death and eventually lead to complete disintegration of the body.

PROXIMAL: Adj: Nearer to the trunk or the origin.

PSYCHOSIS: A group of severe mental disorders in which there is loss of contact with reality and which are usually characterized by hallucinations.

PSYCHOSOMATIC: Pertaining to the mind-body relationship.

PTOMAINS: A group of toxic substances produced by the breakdown of proteins during putrefaction. Formerly believed to be a cause of food poisoning.

PULMONARY: Pertaining to the lungs.

- EMBOLISM: The closure of the pulmonary artery or one of its branches by an embolus.

**- INFARCTION:** An area of necrosis in lung tissue produced by sudden arrest of circulation in a vessel.

**PUPA:** The resting stage in the metamorphosis of certain insects between the larva and the adult form.

**PUTREFACTION:** The disintegration of the tissues brought about by bacterial action.

**- GASES:** Gases evolved in the process of putrefaction, largely hydrogen sulfide, ammonia, methane and carbon dioxide.

**RADIUS:** The outer and shorter bone of the arm, below the elbow.

**RAPE:** Sexual intercourse with a person without consent or with consent when the person is not qualified to give consent (when too young, mentally defective, etc.)

**RECTUM:** The terminal portion of the large intestine. It opens to the outside through the anus.

**RENAL:** Relating to the kidneys.

**RESUSCITATION:** To revive, as in drownings and electrical shocks.

**RETARDATION:** Delay or hindrance.

**RHESUS FACTOR:** A group of antigens carried on the red blood cells first found in the rhesus monkey. Individuals possessing the rhesus factor are said to be "Rh positive," those who do not are said to be Rh negative."

**RIGOR MORTIS:** Syn: Cadaveric stiffening. A stiffening and contraction of the musculature (both voluntary and involuntary) of the body after death.

| | |
|---|---|
| SADISM: | A practice in which pleasure or sexual satisfaction is derived from the infliction of physical or psychologic pain or abuse on others. |
| SAGITTAL: | Adj: In the anteroposterior direction. |
| - PLANE: | An imaginary plane traversing the body in an anteroposterior direction, useful in describing gunshot wounds. |
| SALICYLATES: | A group of drugs used as analgesics, antipyretics and for topical application. Salicylates are commonly involved in suicidal poisons in adults and accidental poisonings in children. |
| SCALD: | A surface injury caused by moist heat. In the skin, preservation of hairs distinguishes a scald from a burn. |
| SCAPULA: | Shoulder blade. |
| SCHIZOPHRENIA: | A mental disorder. |
| SCLERA: | The white of the eye - a tough membrane. |
| SCRATCH: | An abrasion caused by a pointed object passing over the skin. The heaping up of the epidermis at one end may indicate the direction of the scratch. |
| SEAT BELT INJURY: | Abdominal injuries sustained by acute flexion over a seat belt during sudden deceleration. Seat belt injuries include flexion compression fracture of the neck, tears of bowel or mesentery or injury to th pregnant uterus. |
| SECONAL: | Brand of secobarbital (Eli Lilly & Co.). Seconal capsules syn: "pinks," "red birds," "red devils," "seggys." |

| | |
|---|---|
| SECRETOR: | An individual secreting blood group specific substances in the body fluids and secretions such as milk, saliva and seminal fluid. About 80% of the population are secretors. |
| SEDATIVE: | A drug which allays excitement. Sedatives include the barbiturates, bromides and chloral hydrate. In large doses, sedative may act as hypnotics. |
| SEGMENTATION: | Syn: Box car sign. Numerous transverse interruptions of the blood column in the vessels of the choroid of the eye. It has been regarded as one of the earliest signs of death. |
| SEMEN: | Syn: Seminal fluid. A viscous, whitish fluid ejected from the penis during orgasm and consisting largely of spermatozoa and secretions of the prostate gland and seminal vesicles. |
| SEPTICEMIA: | Syn: Blood poisoning, sepsis. The presence of pathogenic bacteria in the blood. |
| SHOCK: | A condition characterized by pallor, low blood pressure, rapid but shallow pulse and clammy perspiration. |
| - PRIMARY: | Syn: Faint, syncope. A transient loss of consciousness due to fear or violent emotion. |
| - SECONDARY: | Syn: Oligemic shock, surgical shock, traumatic shock. A state of shock, often progressing to death, caused by a sudden reduction of circulating blood volume. |
| SINGEING: | Syn: Branding. An area of burned skin or hair surrounding the entrance wound of a bullet fired at close range and caused by hot gases escaping from the muzzle. |

| | |
|---|---|
| SMOTHERING: | Asphyxia produced by the occlusion of the mouth and nostrils, e.g., by a pillow. |
| SMUDGING: | An area of blackening produced by powder gases and surrounding the entrance wound of a bullet fired at close range. |
| SODOMY: | Syn: Buggery. A form of sexual intercourse in which the penis of the active participant is inserted into the anus or the mouth of the passive participant. |
| SPASM: | Sudden, violent, involuntary contraction of a muscle or group of muscles. |
| SPERMATOZOA: | The mature male reproductive cells produced in the seminiferous tubules of the testis. The main cellular constituent of semen. |
| SPLIT: | Syn: Splitting wound. a wound of the skin caused by the compression of the tissue between a hard, blunt object or hard surface and bone. A split may resemble a cut but usually shows ragged edges and contusion of the adjacent tissue. |
| SPRAIN: | The twisting or straining of a joint with injury to the joint capsule or ligaments but without displacement of the bone. |
| SPUTUM: | Matter ejected from the mouth; saliva and mucous. |
| STAB: | Syn: Penetrating wound, perforation, puncture. A wound caused by the penetration of a pointed instrument. In contrast to a cut, the depth of a stab is greater than its width. |
| STAGNANT: | Failure of circulation (for example: shock, cardiac failure). |

| | |
|---|---|
| **STEERING WHEEL INJURY:** | An injury caused by the impact of the steering wheel on the chest and upper abdomen of the driver during sudden deceleration. It frequently includes rupture of the liver and a flail chest. |
| **STILLBIRTH:** | The birth of a dead infant during the last trimester of pregnancy or at term. A infant is regarded as stillborn if it has not shown any sign of life while completely external to the mother. See: Abortion and Miscarriage. |
| **STIPPLING:** | Syn: Powder stippling, tattooing and powder burns. Dispersed particles of burned and unburned gunpowder embedded beneath the skin surface around a bullet wound. |
| **STRANGULATION:** | Death caused by compression or construction of the neck. |
| **- LIGATURE:** | Strangulation by a ligature, such as a rope, stocking, towel, etc. |
| **- MANUAL:** | Syn: Throttling. Strangulation by one or both hands. Manual strangulation frequently causes injury to the thyroid cartilage. |
| **STROKE:** | A sudden or severe cardiovascular attack, with rupture of a blood vessel in the brain. |
| **SUBARACHNOID HEMORRHAGE:** | Bleeding, often spontaneous, sometimes from injury, between the brain and its covering membrane, the arachnoid. |
| **SUBDURAL:** | Under the dura mater, or between the dura and arachnoid membrane covering the brain as in subdural hematoma. |
| **- HEMATOMA:** | Bleeding, almost always from injury, between the inside of the skull and the dura which covers the brain. This accumulation of blood produces pressure on the brain. |

**SUBLUXATION:** A partial dislocation of a joint.

**SUDDEN INFANT DEATH SYNDROME:** See: Syndrome.

**SUFFOCATION:** The stoppage of respiration.

**SYNDROME:** A set of signs and symptoms which occur together.

- **BATTERED CHILD:** The presence in a child of multiple injuries caused by repetitive trauma, generally inflicted by the parents. These injuries, which usually vary in age, may include bruises, fractures, separation of epiphyses, eye injuries, subdural hemorrhage and rupture of organs.

- **CRUSH:** Kidney failure caused by damage to tubules and precipitation of hemoglobin, following severe crushing injuries, usually of the extremities. a similar syndrome may follow incompatible blood transfusions.

- **MALLORY-WEISS:** Vomiting of blood due to a mucosal tear of the gastroesophageal wall. Regarded as a result of vomiting.

- **MENDELSON'S:** An acute hemorrhagic pneumonia caused by the aspiration of gastric acid. Often a complication of obstetrical anesthesia or of vomiting in the debilitated or immobilized patient.

- **REYES:** A usually fatal syndrome in infants and young children consisting of hyperexcitability, seizures, hepatomegaly and hypoglycemia. At autopsy, cerebral edema and a fatty liver are found.

| | |
|---|---|
| - SUDDEN INFANT DEATH: | Syn: Crib death, SIDS. Sudden death in apparently well infants, usually between the third and sixth months of life, with negative or minimal autopsy findings. |
| TATTOO: | Syn: Powder stippling. An area of burned grains near the entrance wound of a bullet fired at close range. |
| TEMPERATURE PLATEAU: | The period immediately after death during which the internal body temperature does not fall. The temperature plateau may last 1-5 hours. |
| TEMPORARY CAVITY: | A momentary cavity created in the tissues by the rapid passage of a missile, causing much disruption. The size of the temporary cavity depends upon the energy of the missile and its rate of transfer to the tissues. The space remaining after the collapse of the temporary cavity is the permanent cavity. |
| T.H.C: | Tetrahydrocannabinol, a constituent of hashish and marijuana. |
| THROMBOSIS: | Blood clotting inside the blood vessels, often in leg veins. |
| - CORONARY: | Thrombosis narrowing or occluding the lumen of the coronary artery. |
| THROMBUS: | A solid coagulum formed in circulating blood in the blood vessels or chambers of the heart, its structure being largely determined by the turbulence of the blood. Its architecture thus differs from that of a clot. |
| - MURAL: | A thrombus attached to the wall of a blood vessel or heart chamber. |

| | |
|---|---|
| THYROID CARTILAGE: | The main cartilage of the larynx. It has two posterior projections on either side which are frequently broken in cases of strangulation. |
| TIBIA: | The inner and larger bone of the leg below the knee. |
| TORSO: | The trunk of the body without the head or extremities. |
| TOXIC: | Adj: Pertaining to, caused by or acting as a poison. |
| TOXICOLOGY: | The science of the nature of poisons, their effects and detection. |
| TOXIN: | A poisonous substance produced by bacteria, animals or plants. |
| TRACHEA: | Syn: Windpipe. A cartilagenous tube connecting the larynx with the bronchi. |
| TRACHEOSTOMY: | Syn: Tracheotomy. A surgical operation making an opening in the neck to facilitate breathing |
| TRANQUILIZERS: | A drug which sedates and reduces anxiety. The tranquilizers include the pheonthiazines, diazepines and butyrophenones. |
| TRANSSEXUAL: | A disturbance of gender identity in which the person feels a lifelong discomfort with his or her own sex and a compelling desire to be of the opposite sex. |
| TRANSVESTITE: | An individual obtaining sexual gratification by wearing the clothing of the opposite sex. |
| TRAUMA: | A wound or injury. |
| - TRAUMATIC ASPHYXIA: | See: Asphyxia. |
| TREMOR: | An involuntary trembling or quivering. |

| | |
|---|---|
| TUINAL: | Brand of sexobarbital and amobarbital (Eli Lilly and Co.). Tuinal capsules Syn: "double trouble," "rainbows," "tooies." |
| ULCER: | An open sore of skin or mucous membrane. |
| ULNA: | The inner and larger bone of the forearm. |
| UMBILICAL CORD: | A cord connecting the navel of the fetus with the placenta and containing two arteries and one vein. |
| UNCONSCIOUS: | Same as comatose. No response to any stimuli. THE PERSON IS NOT DEAD. |
| UREMIA: | Presence of urinary materials in the blood. The person is unable to eliminate urine due to kidney failure. |
| UTERINE TUBES: | See: Fallopian tubes. |
| UTERUS: | Syn: Womb. A muscular hollow organ in the female in which the embryo develops. |
| VAGAL INHIBITION: | Syn: Vagal reflex. Stoppage of the heartbeat through stimulation of the vagus nerve. Vagal inhibition may be caused by pressure on the neck, immersion in cold water, minor surgical procedures, etc. |
| VAGINA: | The tubular musculofibrous passage in the female connecting the vulva with the cervix. |
| VAGUS: | The tenth cranial nerve originating in the brain stem, passing through the neck and chest and supplying branches to the larynx, heart, lungs, stomach and abdominal cavities. |

| | |
|---|---|
| VASCULAR: | Pertaining to or full of blood vessels. |
| VEIN: | A blood vessel carrying blood from the tissues to the heart. |
| VENA CAVA: | Superior main vein draining the abdominal and pelvic viscera and the lower extremities. |
| VENTRAL: | Relating to the front of the body. |
| VENTRICLES: | 1. The two lower, more muscular chambers of the heart. |
| | 2. Four intercommunicating cavities in the brain into which the cerebrospinal fluid is secreted. |
| VENTRICULAR FIBRILLATION: | Irregular and ineffective contractions of the ventricles of the heart leading to sudden death. |
| VESICLE: | See: Blister. |
| VIABILITY: | As applied to a fetus, the stage of development at which it would be capable of extrauterine existence. Variously given as 20-24 weeks of gestation. |
| VISCERA: | The large interior organs of the body. |
| VITAL: | Adj: Characteristic of or essential of life. |
| - REACTION: | A reaction in a tissue, such as inflammation, occurring during life and thus used to distinguish antemortem from postmortem wounds. |
| - SIGNS: | Physical signs such as respiration and pulse, indicative of the presence of life. |

VULVA: The external female sexual organs consisting of the vestibule, clitoris, labia majora and labia minora.

WASHERWOMAN'S HANDS: A wrinkling of the skin of the hands and feet caused by prolonged exposure to moisture. May occur before or after death.

WHIPLASH INJURY: An injury to the tissues of the neck caused by a sudden overextension of the cervical spine. It is common in rear end collisions. The injury usually involves the muscles and spinal ligaments, but in severe cases may damage the intervertebral discs, esophagus, trachea and sympathetic chain.

WIPING: Syn: Ring of dirt. Dirt and lubricant from the gun barrel and surface dirt from the bullet deposited on edges of a gunshot wound when there is no intermediate target. May be minimal or absent in non-lubricated ammunition (automatic or semi-automatic weapon).

WOUND: An injury to the body caused by exterior violence.

- DEFENSE: A wound, usually on the fingers, hands or forearms of the victim of an attack, sustained while trying to grasp a weapon or ward off the assailant. The nature of the wound depends on the weapons used for assault.

- PENETRATING: A wound which extends into an organ or tissue, having both and entrance and an exit opening.

PERFORATING: A wound which completely transverses an organ or tissue, having both an entrance and an exit opening.

**X-RAYS, SOFT:** Syn: Grenz rays. X-rays of lower voltage than those used for diagnostic purposes. Important use in identifying entrance gunshot wounds which may have small particles of metal present on clothing or skin.

**ZYGOMA:** Cheek bone.

## NOTES

BLANK PAGE

## NOTES

BLANK PAGE

P - PROCEED TO SCENE AND ASSESS SITUATION

R - RENDER AID TO INJURED

E - EFFECT ARREST

L - LOCATE WITNESSES

I - INTERVIEW COMPLAINANT AND WITNESSES

M - MAINTAIN CRIME SCENE AND PROTECT EVIDENCE

I - INFORM OTHER POLICE OFFICERS

N - NOTE ALL CONDITIONS, EVENTS AND REMARKS

A - ARRANGE FOR SEARCHING SCENE AND COLLECTING EVIDENCE

R - REPORT THE INCIDENT

Y - YIELD RESPONSIBILITY

BLANK PAGE

* * * * *

# Post Mortem Changes and Time of Death

* * * * *

BLANK PAGE

**Death Investigation**

**Post Mortem Changes and Time of Death**

By Arthur E. Westveer
National Center for the
the Analysis of Violent Crime
Behavioral Science Instruction
and Research Unit

BLANK PAGE

## Post Mortem Changes and Time of Death

1. Necessary interdependent systems for life
   A. Respiratory system
   B. Circulatory system
   C. Central nervous system

2. The only accurate method of determining the time of death is to be there when it happens; and even then you have a small margin of error.

3. There is currently NO SINGLE ACCURATE MARKER of the time of death.

4. USE CONSIDERABLE CAUTION on time of death estimates.

5. Post mortem interval or window of death questions to be asked are:
   A. When could death have occurred?
   B. When was the deceased last known to be alive and when was the body found?

6. Observations
   - Degree of rigor
   - Amount and position of livor
   - Body temperature
   - Presence of fly eggs or larvae

7. Reasonable range of death
   1. Experience and caution of the investigator
   2. Classic death markers
   3. Well established window of death

8. Changes after death
   1. Early
   2. Late
   3. Tissue changes

9. Early changes after death
   1. Cessation of respiration
   2. Cessation of circulation
   3. Skin pallor
   4. Muscle relaxation
   5. Eye changes - cornea, retina
   6. Blood coagulation and fluidity

10. Late changes after death
    1. Algor Mortis
    2. Livor Mortis
    3. Rigor Mortis

11. Algor Mortis (cooling of the body after death) one of the classic markers of death
Body temperature is a narrow range not a fixed temperature. Activity, illness, decomposition, infection, absorption of heat can maintain or rise body temperature after death.

12. Bodies are cooled by
- Radiation
- Convection
- Direct transfer
- Any factors that influence heat loss affect rate
- Careful consideration of the scene, clothing, victim size, and activity have to be considered in estimating cooling time.

13. $$\frac{98.4 - \text{Measured rectal Temperature}}{1.5} = \text{1 hour since death}$$

14. Livor Discoloration

| | |
|---|---|
| Red Purple | - Usual |
| Pink | - Cyanide or cold temperature |
| Cherry Red | - Carbon Monoxide |
| Brown | - Nitrates |

Color varies according to skin pigmentation

15. Tardeau's Spots
Gravity causes capillaries in a small area to rupture, resulting in circular areas of skin hemorrhage.

Size is important - 4-5mm or larger

16. Rigor Mortis
Classic marker of death
Heat accelerates the process
Cold Decellerates the process
- Mechanism - physical change
- Onset - immediate
- Manifested - 1-6 hours
- Maximum - 6-24 hours
- Disappears - 12-36 hours

17. Rigor Mortis interpretation is not reliable
- Illness
- Temperature
- Activity before death
- Physical conditions where the body is placed or found
- May be poorly formed in the young or the old

18. Environmental factors that may have changed with time.
    1. Sun shining on victim
    2. Air conditioner blowing on the body

19. Cadaveric Spasm
    1. Focal instant rigor
    2. Seen in sudden death
    3. Medicolegal importance
        A. Grasping of a weapon
        B. Grasping of evidence
        C. Position

20. Post Mortem Tissue Changes
    1. Decomposition
    2. Skeletonization
    3. Mummification
    4. Adipocere

21. Decomposition
    1. Autolysis
    2. Putrefaction

22. Autocysis
    The process after death by which digestive enzymes within the body cells break down carbohydrates and proteins.

23. Putrefaction
    1. Gas formation and bloating
    2. Green discoloration of the abdomen
    3. Marbling - along blood vessels
    4. Loss of hair and nails

24. Petechial Hemorrhage
    Suggestive of asphyxia
    usually 1mm or smaller

25. Skeletonization
    1. Removal of soft tissue
    2. Flies, beetles and animals
    3. Forensic entomology

26. Mummification
    Drying of the body or its parts with leather like changes

27. Adipocere
    1. Wax formed - not a soap
    2. Hydrogenation of body fats
    3. Specific requirements
        A. Moisture
        B. Anerobic environment

28. Problems associated with the time of death

1. Life insurance policies
2. Implicating or excluding a suspect
3. Time of assault vs time of death
4. Always an estimate

# STANDARDS CURRENTLY EMPLOYED

# TO DETERMINE TIME OF DEATH

Patricia J. McFeeley, M.D.
Chief Medical Investigator
State of New Mexico
Albuquerque, New Mexico

VICAP INTERNATIONAL SYMPOSIUM
Quantico, Virginia
June 19 - 23, 1988

BLANK PAGE

## ***** KEY POINTS *****

The only accurate method of determining the time of death is to be there when it happens; and even then you have a small range of error.

There is currently no single accurate marker of the time of death

The closer to the actual time of death, the more accurate is the opinion possible from the scene and markers of death.

The experience and caution of the investigator, coupled with the classic death markers and a well established window of death can lead to a reasonable range of death.

To determine the probable range of death, first establish a window of death. When could death have occurred ? When was the deceased last known to be alive and when was the body found. This difference is the range of time wherein death could have occurred

Next, use those scene markers that allow some positioning of the death within that window-morning newspaper read, phone calls made, type of meal consumed, place and state of dress.

Next, adjust this preliminary opinion by any additional data-i.e. that issue of the newspaper could have been available late the night before; the man works nights and sleeps days, etc.

Consider environmental factors and factors that may have changed with time: i.e. sun shining on victim, air conditioner blowing on body.

Use observations of the degree of rigor, amount and position of livor, body temperature, presence of fly eggs or larvae etc. to further refine opinion.

Use the temperature and vitreous potassium or other testing to further refine opinion.

As a summation, use considerable caution on time of death determinations, as there can be factors that markedly enhance or retard the chemistry of death and its changes.

Accentuate giving range of death and basis for determination.

Don't attempt to make your opinions more accurate than the data allows.

Ensure that you specify that these are preliminary findings or your final opinion, whichever is correct.

## RIGOR MORTIS

One of the classic markers of death, its normal sequence is well documented in history. In Michelangelo's famous statue of Christ's being taken from the cross, the flacity typical soon after death is clearly evident. Muscular relaxation immediately after death is followed by the onset of gradual rigidity without shortening of the muscle. Since muscle continues to metabolize for a short time after somatic death, or from products built up during the death event, glycogen is converted into lactic acid. As the pH falls, there is a physical change in the muscle protoplasm. Since there is no regeneration of ATP in dead muscle, this process proceeds in one direction only. The sol is converted into a gel as the actin of the muscle is physically changed.

Perception of rigor is more rapid in the smaller muscles, leading to the misbelief that this process started in the head and worked down the body. All muscles are affected at a similar rate; rigor is more evident in the short, smaller muscles earlier than in the longer, larger muscle masses.

Since this is a chemical process, heat accelerates and cold decelerates the process. Acidosis, uremia or other medical conditions promoting a lowered pH accelerate the process.

The very perception of rigor depends on experience and conditi
A very cold body may appear stiff because of changes in the fat layer.

| MECHANISM | ONSET | MANIFESTED | MAXIMUM | DISAPPEARS |
|---|---|---|---|---|
| Physical chg | immed | 1-6 Hrs | 6-24 Hrs | 12-36 + Hrs |

Rigor is typically quantitated by mild or early,moderate or mid and full or complete as a descriptive statement of degree of change. This is totally subjective, and two observers may have different interpretations. Usually, perceived stiffness in motion of a joint is mild, difficulty requiring force to move a joint is moderate, and having to use great force is full rigor.
Once the physical change of the muscle is forced, that degree of change will not reoccur, so that if someone has broken the rigor, it will not reform if to completion. If only partial, some rigor will continue to form.
This is a <u>unreliable method</u> of indicating the time of death. It is affected by illness, temperature, activity before death, and the physical conditions where the body is placed or found. It may be poorly formed in the young or the old. It is a aid in the general determination of death at best, and should not be relied on as a single indicator of the time of death.

LIVOR MORTIS
(SYNONYMS: POSTMORTEM HYPOSTASIS, LIVIDITY, SUGGILLATIONS, GRAVITATION)

Known since antiquity, the settling of blood to the dependent parts of the body has been recognized as a change of death. When cardiac activity stops the hydrostatic pressure of the liquid blood causes it to settle and distend the dependent capillary bed. The color of the dependent part will depend on the skin pigment and any additional compounds in the blood that may affect color, such as carbon monoxide, but it is generally dark blue or purple.

Livor begins at or very soon after death since it is a function of blood flow and, therefore, cardiac activity. However, stasis can occur to some extent in shock and some degree of lividity can be present even while a person is technically alive.

| MECHANISM | ONSET | MANIFESTED | MAXIMUM | DISAPPEARS |
|---|---|---|---|---|
| SETTLING | IMMED | 2-4 HRS | 8-12 HRS | ---- |

There are factors that will accelerate or retard the onset of visible livor, and the disappearance rate is similarily variable.

TARDIEU'S SPOTS
When the accumulated area engorged with blood is large, gravity can cause capillaries in a small area to rupture so that larger, usually circular or rounded areas of skin hemorrhage occur. These have to be differentiated from the much smaller petechial hemorrhages more suggestive of asphyxia. Size is important since these areas are usually 4-5 mm or larger in diameter, whereas petechiae are usually 1mm or smaller in diameter.

Livor will not usually develop where there is pressure from clothing or objects so important information regarding whether a patient was clothed for a period of time after death or if his position was changed can be gained from a careful inspection of livor's distribution. Generally, time can at best be supported from observation of livor and comparison with the accelerating or decelerating factors affecting that scene.

## Algor Mortis (Cooling after Death)

The metabolism of the tissue generates heat which is very tightly regulated by the body to a narrow range. Cooling of the body after death is another of the classic markers of death. If the body always cools at a uniform rate, then that slope would enable an accurate determination of the time of death.
However, the body temperature is a narrow <u>range</u> not a fixed temperature. Activity, illness, decomposition, infection and absorption of heat can maintain or <u>raise</u> body temperature after death. The body cools by radiation, convection and direct transfer, so that any factors that influence heat loss affect rate. Careful consideration of the scene, clothing, patient size and activity and physical factors have to be considered in interpreting cooling rate.

Over the years, there have been a number of formulas proffered that would, in theory, allow the calculation of the time of death.

(Glaister) $\dfrac{98.4 - \text{measured rectal temperature}}{1.5}$ = hours since death

In Fatteh is the statement that the cooling of the body is the most reliable factor for the first 12-18 hours, but he points that exercise or struggle could raise the temperature from 9' by 3-4°, sleep lowers etc. He included the warning that deg of fatness, age, ventilation all changed the rate, and that clothing was 66% slower and water 2X as fast.

Marshall and Hoar, in a series of articles on this topic stated that the rate was not uniform, but 1°/hr for the first three hours, then 2°/hr for the next six hours then 1 1/2°/hr for the next three, etc.

Spitz and Fisher caution that they had observed cases where 93° was reached in as short a time as 2 hours and as late as 6 hours. Temperature has to be considered in light of all the scene data, consideration for any altering factor, and then carefully. For example, a person dead in a closed car all day with the sun shining on the car who is then observed at night could not be expected to cool in a regular fashion, and in fact may well have an elevated or normal temperature.

VITREOUS POTASSIUM

A study of cell physiology revealed that the cell maintains a increased concentration of potassium in the intracelluar fluid, 20 to 40 times the concentration in the plasma. This high concentration requires a balance between the electrical charges inside and outside the cell membrane and is maintained in this relatively high concentration by active metabolic forces that "pump" the electrolytes selectively across the membrane. A return to equilibrium occurs after death at a steady rate because the pumping mechanism is no longer active and the cell wall now becomes a semipermeable membrane that allows the potassium to leak through the membrane to approach equilibrium. The leak is at a steady rate because of the mechanical limits of the membrane. This steady rate provides a built-in clock that allows a projection back to the time of death. Since blood hemolyzes and loses potassium, it becomes unreliable for analysis. An ideal sample, protected from most trauma, is the vitreous fluid of the eye.

Sturner and Gantner developed a formula for estimating time of death based on a uniform $K^+$ leak rate of 0.14 mEq/L/hr. The formula is:

$(7.14 \times K^+ \text{ conc}) - 39.1 = $ hours since death

i.e. $(7.14 \times 8.1) - 39.1 = 18.7$ or approximately 19 hours since death.

Coe published similar findings. Soon after this data was published the formula was found inapplicable for some locations and/or situations. The authors and Dr. Coe suggest that you determine the rate for your specific area, and you may require different charts for different seasons. The concept is valid, but it has to be interpreted in light of regional variations and with consideration for accelerating or decelerating factors.

## METHODS FOR ESTIMATION OF TIME OF DEATH

**RATE METHODS (i.e. estimation of tree's age by height/rate of growth)**

- Rate of drying or discoloration of blood pools
- Rigor Mortis
- Livor Mortis
- Algor Mortis
- Decompostion
- Flora (plants) around body
- Fauna (insects) around body

**CONCURRENCE METHODS (i.e. estimation of tree's age by counting rings)**

- Blood stain vs tire
- Time of last known meal
- Stopping of watch
- Depth of footprint in snow
- Depth of rainwater collected

## EVIDENCE FOR ESTIMATION OF TIME OF DEATH

1. CORPORAL EVIDENCE - In the body
2. ENVIRONMENTAL AND ASSOCIATED EVIDENCE - In the vicinity and general surroundings
3. ANAMNESTIC EVIDENCE - Based on the decedent's ordinary habits and daily activities

| Corporal Evidence | Envir. & Assoc. Evidence | Anamnestic Evidence |
|---|---|---|
| - stage of decomp of organs vs exterior<br>- soot in airway<br>- medical conditions (ASCVD, prev surgery)<br>- alcohol/drug levels<br>- beard, nails, hair | - uncollected milk, mail, newspapers<br>- lights on/off<br>- alarm clock set<br>- food on stove/ in refrig<br>- type of clothing<br>day/night<br>indoors/outdoors<br>seasonal (remote deaths)<br>condition of clothing (mold, leached dyes)<br>- sales slips, receipts<br>- animals in house | - usual activities<br>- waking & sleeping patt<br>- eating habits, times, types of foods<br>- appointments |

Use a combination of all evidence available to you, giving weight to the more reliable/ documentable. Be suspicious when some factors seem to va considerably from the others.

## OCULAR CHANGES*

| | eyes open | eyes closed |
|---|---|---|
| 1. Ophthalmoscopic exam | | |
| "boxcaring" in vessels | -- w/in ½ hr (indication of death) -- | |
| ? time interval changes | (ref. Kevorkian; JFS 1961) | |
| 2. Corneal film | minutes | several hours |
| 3. Scleral discoloration "tache noire" | min to sev hrs | |
| 4. Corneal cloudiness | 2 hrs or less | 12-24 hrs |
| 5. Corneal opacity | | 3rd PM day |
| 6. Exophthalmos (bulging) | -- with gas formation -- | |
| 7. Endophthalmos (retraction) | -- advanced decomposition -- | |

*All depend on lid position, temperature, humidity and air currents

## FOOD IN STOMACH

| SIZE OF MEAL | TIME IN STOMACH (starts to empty w/in 10 min) |
|---|---|
| Light | 1½ - 2 hrs |
| Medium | 3 - 4 hrs |
| Heavy | 4 - 6 hrs |
| | (head of meal reaches cecum 6-8 hrs) |

Variations:

Liquid faster than Semisolid faster than Solid

Emotional State: Psychogenic pylorospasm - prevent emptying for several hrs

Hypermotility - diarrhea

(Study of condemned men following judicial execution - rate throuch sm bowel = 6-7ft/hr reached cecum 3-3½hrs)

*Cannot rely on amount of digestion

## STAGES OF POSTMORTEM DECOMPOSITION

1. Blue-green discoloration of skin

| | |
|---|---|
| RLQ and LLQ abdomen | 24 hrs |
| Entire abdomen | 36 hrs |

2. Marbling (Green-black discoloration in blood vessel distribution-
hemolyzed blood reacts with hydrogen sulfide

Extravasation diffusion (leads to generalized dark purple-black skin)

3. Bloating (crepitus most marked in areas of loose skin - scrotum, penis, eyelids) — 36-48 hrs

4. Entire body decomposition — 60-72 hrs

5. Skin slippage (epidermolysis) — 4-7 days
   with vessicle formation and collapse
   hair and nails loosen and shed
   "glove" formation of hands and feet

6. Saponification/Adipocere — (usually) several months
   prolonged exposure to moisture in assoc with organisms (C. Welchii)
   involves subcutaneous fat
   oleic acid (unsaturated/liquid) hydrogenated to stearic acid (saturated/sol

Mummification
   drying preceeds or interrupts decomposition
   (bacterial growth arrested with body moisture less than 50%)

Skeletonization — weeks to years

## FACTORS INFLUENCING POSTMORTEM DECOMPOSITION

1. Environmental factors: Temperature
   Humidity
   Location (indoors vs outdoors)
   Clothing

   - heat increases rate (intense heat may decrease- "heat fixation")
   - cold decreases rate
   - freezing/thawing
   - insects and soil (work from outside in)
   - micro-organisms (work from inside out)

2. Body habitus: Newborns (sterile alimentary trac
   Obese vs thin

3. Cause of death: Exsanguination (may delay)
   Infection, CHF, anasarca (accelerates)

## EXTENSIVELY DECOMPOSED/ SKELETONIZED REMAINS

Should be treated as anyother case, i.e. careful examination and documentation of scene, collection of evidence, etc.

Best approach is to plan ahead (another day at this stage will probably not change the scene significantly but could make the final conclusions better).

***Use the services of a forensic anthropologist liberally and early***

Weathering of bones depends considerably on
- Buried or not buried
- Climate
- Moisture
- Elevation
- Terrain
- Protection
- Insects/animals (human)intervention

Scene conditions should be photographed, sketched, measured, etc for later interpretation. Collect plants when appropriate. Check weather bureaus for rainfall, temperatures, etc.

Interpretations must take into account the local conditions -- results vary widely with different areas of the country.

### INSECT INTESTATION (FAUNA) = Useful for establishing a minimum postmortem interval

1. Body lice - outlive host by 3-6 days

2. Blow flies (diptera)
   - may deposit ova before or at death
   - larva (maggot) - hatch 18-24 hrs (strongly proteolytic- may exaggerate size/ obliterate penetrating wounds)
   - pupae/casings - ± week

3. Insects/arthropods (temp greater than 40°F)

*Highly dependent on locale, temperature, season

*Collect representative samples in preservative (85% alcohol) and take to an entomologist

### PLANT LIFE (FLORA)

1. Grass/plants beneath an object wilt, turn yellow or brown and dies (rate depends on type of plant, season, climate, etc)

2. Seasonal plants or remnants may help indicate a range of time

3. Collect dead and dying grasses, twigs, flowers, etc and take to a local botanist

## REFERENCES


1. Mortiz, A.R., "Classical Mistakes in Forensic Pathology", Am. J. of Clinical Pathology, Vol. 26, pp 1383-1397, December 1956.

2. Kevorkian, J., The Fundus Oculi as a "Postmortem Clock", J. Forensic Sciences, 6:261, 1961.

3. Gantner, G.E., Sturner, W.Q., Caffrey, P.R. and Brenneman, C., Ascorbic Acid Levels in the Postmortem Vitreous Humor: Their Use in the Estimation of Time of Death, J. Forensic Medicine, 9:150, 1962a.

4. Gantner, G.E., Sturner, W.Q., Caffrey, P.R. and Brenneman, C.: Ascorbic Acid Levels in the Postmortem Vitreous Humor: Their Use in the Estimation of Time of Death, J. Forensic Medicine, 9:156, 1962b.

5. Coe, John I., Postmortem Chemistries on Human Vitreous Humor, Am. J. of Clinical Pathology, Vol. 51, No. 6, September, 1969.

6. Fatteh, A., Handbook of Forensic Pathology, 1973.

7. Adelson, L., The Pathology of Homicide, 1974.

8. Camps, F., Robinson, A.E., Lucas, B.G., Gradwohls Legal Medicine, third edition, 1976.

9. Burton, John F., The Estimated Time of Death, Legal Medicine Annual, 1976.

10. Carlsson, A. and Winblad, B., Influence of Age and Time Interval Between Death and Autopsy on Dopamine and 3-Methoxytyramine Levels in Human Basal Ganglia, J. of Neural Transmission, 38,271-276, 1976.

11. Spitz, W.U., Fisher, R.S., Medicolegal Investigation of Death, Second Edition, 1980.

12. Henry, J.B., Smith, F.A., Estimation of the Postmortem Interval by Chemical Means, Am. J. of Forensic Medicine and Pathology, Vol 1, No. 4, December 1980.

13. Kouichi Hiraiwa, Youkichi Ohno, Fusakuni Kuroda, Ismail M. Sebetan, Shigemi Oshida, Estimation of Postmortem Interval from Rectal Temperature by Use of Computer, Med. Sci. Law, Vol. 20, No. 2, 1980.

14. Kouichi Hiraiwa, Toshiyuki Kudo, Fusakuni Kuroda, Youkichi Ohno, Ismail M. Sebetan, Shigemi Oshida, Estimation of Postmortem Interval from Rectal Temperature by Use of Computer - Relationship Between the Rectal and Skin Cooling Curves, Med. Sci. Law, Vol 21, No. 1, 1981.

15. Fusakuni Kuroda, Kouichi Hiraiwa, Shigemi Oshida, Suguru Akaishi, Estimation of Postmortem Interval from Rectal Temperature by Use of Computer (III) - Thermal Conductivity of the Skin, Med. Sci. Law, Vol. 22, No. 4, 1982.

16. Zumwalt, R.E., Bost, R.O., and Sunshine, I., Evaluation of Ethanol Concentrations in Decomposed Bodies, J. of Forensic Sciences, July 1982.

17. Moar, J.J., Determining the So-Called Moment of Death in Homicide Victims, SA Medical Journal, Vol. 62, July 1982.

18. Sturner, W.Q., Sullivan, A., and Suzuki, K., Lactic Acid Concentrations in Vitreous Humor: Their Use in Asphyxial Deaths in Children, J. of Forensic Sciences, Vol. 28, No. 1, January 1983, pp. 222-230.

19. Nokes, L.D.M., Brown, A., and Knight, B., A Self-contained Method for Determining Time Since Death from Temperature Measurements, Med. Sci. Law, Vol. 23, No. 3, 1983.

20. Gordon, I., Shapiro, H.A., Forensic Medicine, Second Edition, 1983.

21. Polson, C.J., Gee, D.J. and Knight, B., The Essentials of Forensic Medicine, Fourth Edition, 1985.

22. Green, M.A., and Wright, J.C., Postmortem Interval Estimation from Body Temperature Data Only, Forensic Science International, 28, 35-46, 1985.

23. Green, M.A., and Wright, J.C., The Theoretical Aspects of the Time Dependent Z Equation as a Means of Postmortem Interval Estimation Using Body Temperature Data Only, Forensic Science International, 28, 53-62, 1985.

24. Gorman, W.F., Medical Diagnosis Versus Legal Determination of Death, J. of Forensic Sciences, Vol. 30, No. 1, January 1985, pp. 150-157.

25. Horowitz, M., Pounder, D.J., Gastric Emptying - Forensic Implications of Current Concepts, Med. Sci. Law, Vol. 25, No. 3, 1985.

26. Horowitz, M., Pounder, D.J., Is the Stomach a Useful Forensic Clock?, Aust. NZ Med. 1985.

27. Erzinclioglu, Y.Z., The Entomological Investigation of a Concealed Corpse, Med. Sci. Law, Vol. 25, No. 3, 1985.

28. Coe, J.I., and Apple, F.S., Variations in Vitreous Chemical Values as a Result of Instrumentation, J. of Forensic Sciences, Vol. 30, No. 3, July 1985, pp. 828-835.

29. Brown, A., Hicks, B., Knight, B., Nokes, L.D.M., Determination of Time Since Death Using the Double Exponential Cooling Model, Med. Sci. Law, Vol. 25, No. 3, 1985.

30. Nokes, L.D.M., Hicks, B., and Knight, B.H., The Postmortem Temperature Plateau - Fact or Fiction?, Med. Sci. Law, Vol 25, No. 4, 1985.

31. Nokes, L.D.M., Hicks, B., Knight, B., The Use of Trachea Temperature as a Means of Determining the Postmortem Period, Med. Sci. Law, Vol. 26, No. 3, 1986.

32. Sparks, D., Hunsaker, J.C., and Slevin, J.T., Postmortem Accumulation of 3-Methoxytyramine in the Brain, NEJM letters, August 23, 1985, p. 540.

33. Sparks, D., Slevin, J.T., and Hunsaker, J.C., 3-Methoxytyramine in the Putamen as a Gauge of the Postmortem Interval, J. of Forensic Sciences, Vol. 31, No. 3, July 1986, pp. 962-971.

34. Micozzi, M.S., "Experimental Study of Postmortem Change Under Field Conditions: Effects of Freezing, Thawing, and Mechanical Injury," J. of Forensic Sciences, JFSCA, Vol. 31, No. 3, July 1986, pp. 953-961.

35. Dragovic, L.J., Anderson, G., Mirchandani, H., and Oxenkrug, G., Determination of Postmortem Interval Based on Circadian Variation (Nyctohemeral Rhythm) of Pineal Beta-Receptors and Melatonin, Scheduled for presentation at American Academy of Forensic Sciences 39th annual meeting in San Diego, CA, February 16-21, 1987.

# TIME OF DEATH ESTIMATES

**ALGOR MORTIS** - (BODY COOLING)

GENERAL RULE: 1.5 DEGREES PER HOUR - WHEN ROOM TEMPERATURE IS ABOUT 70 DEGREES

DR. SIMPSON: 2.5 DEGREES AN HOUR FOR FIRST 6 HOURS AND AVERAGE 1.5 TO 2 DEGREES LOSS PER HOUR OVER FIRST 12 HOURS

DR. RHODES, GORDON & TURNER:

1.5 DEGREES FOR FIRST 12 HOURS AND 1 DEGREE FOR NEXT 12 TO 18 HOURS

FACTORS:

- BODY TEMPERATURE AT TIME OF DEATH
- BODY SIZE (FAT SLOWER, CHILD FASTER, ETC.)
- CLOTHING OR DOVERING
- ENVIRONMENTAL TEMPERATURE (WIND, HIGH HUMIDITY INCREASE EVAPORATION OF WATER & HASTEN COOLING
- IMMERSION IN WATER (GOOD CONDUCTOR)

## TIME OF DEATH ESTIMATES

**RIGOR MORTIS** - (STIFFENING OF MUSCLE TISSUE)

**GENERAL RATES:** ("AVERAGE CLOTHED ADULT")

OBSERVABLE IN SMALL MUSCLES FIRST

DETECT - 2 TO 4 HOURS
COMPLETE - 6 TO 12 HOURS
REMAINS - 12 TO 18 HOURS
BEGINS TO LEAVE - 24 TO 36 HOURS
GONE - 40 TO 60 HOURS

**EXCEPTIONS** - HAS BEEN GONE IN 9 TO 12 HOURS
STILL IN - 45 TO 60 HOURS

**FACTORS:** BODY TEMPERATURE AT DEATH
HIGH/LOW ENVIRONMENTAL TEMPERATURE
HEAT - HASTENS
COLD - RETARDS
STRENUOUS MUSCULAR ACTIVITY
EMOTIONAL EXCITEMENT

# TIME OF DEATH ESTIMATES

**LIVOR MORTIS:**

**FACTORS:** * CIRCULATORY FAILURE (STAGNATION)
(SKIN LIVID PRIOR TO DEATH)

* CHRONIC ANEMIA - OR ACUTE BLOOD LOSS-
LIVIDITY LESS MARKED
* CARBON MONOXIDE POISONING
* CYANIDE POISONING
* CASE OF RAPID COOLING - SNOW - WATER

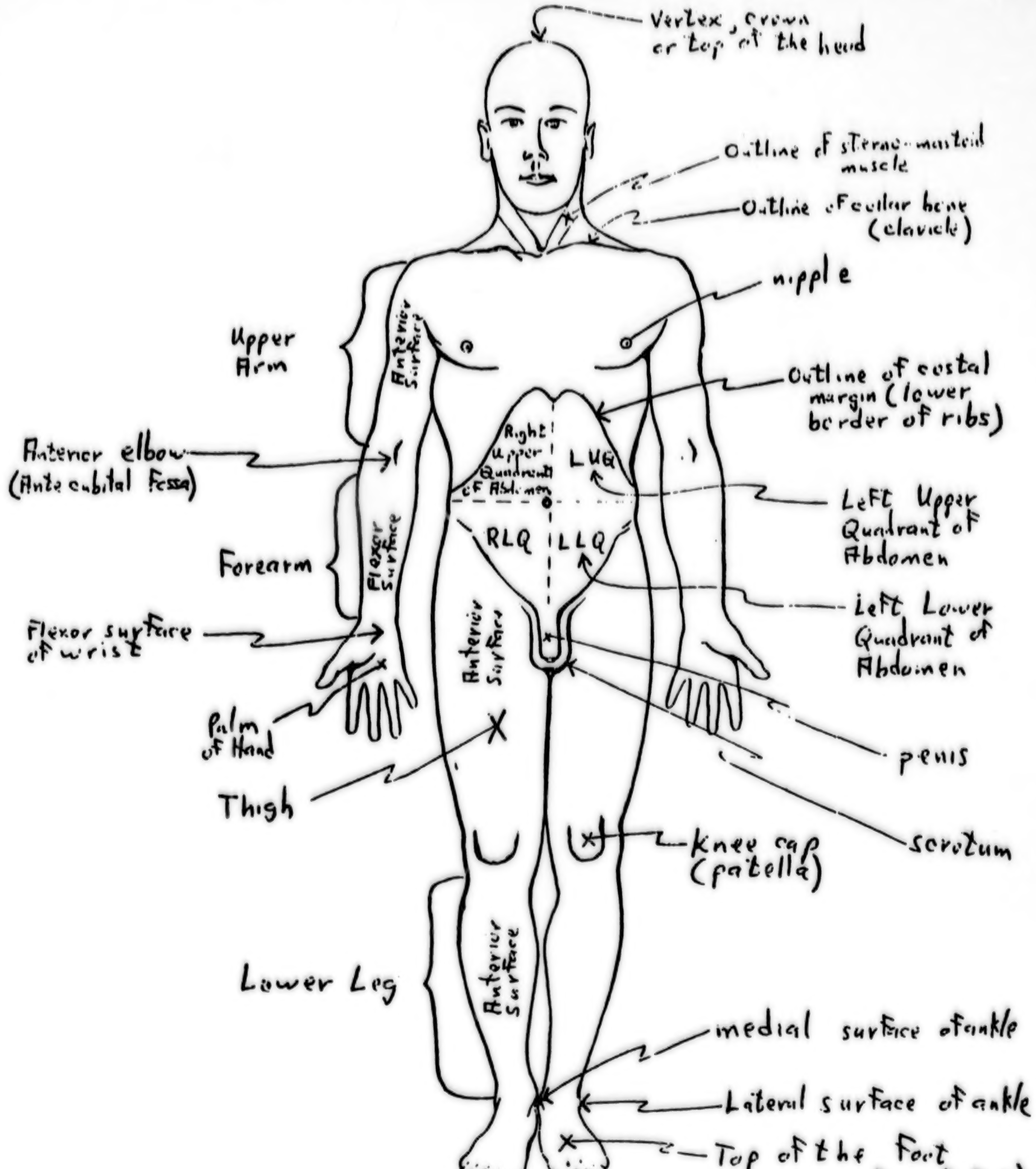
"TARDIEU'S SPOTS" } = OVER CONGESTION OR BLOOD IN CAPILLARIES
PETECHIAE

**RATE:** VISBLE - ½ TO 4 HOURS
WELL DEVELOPED 3 - 4 HOURS
MAXIMUM - 8 - 12 HOURS

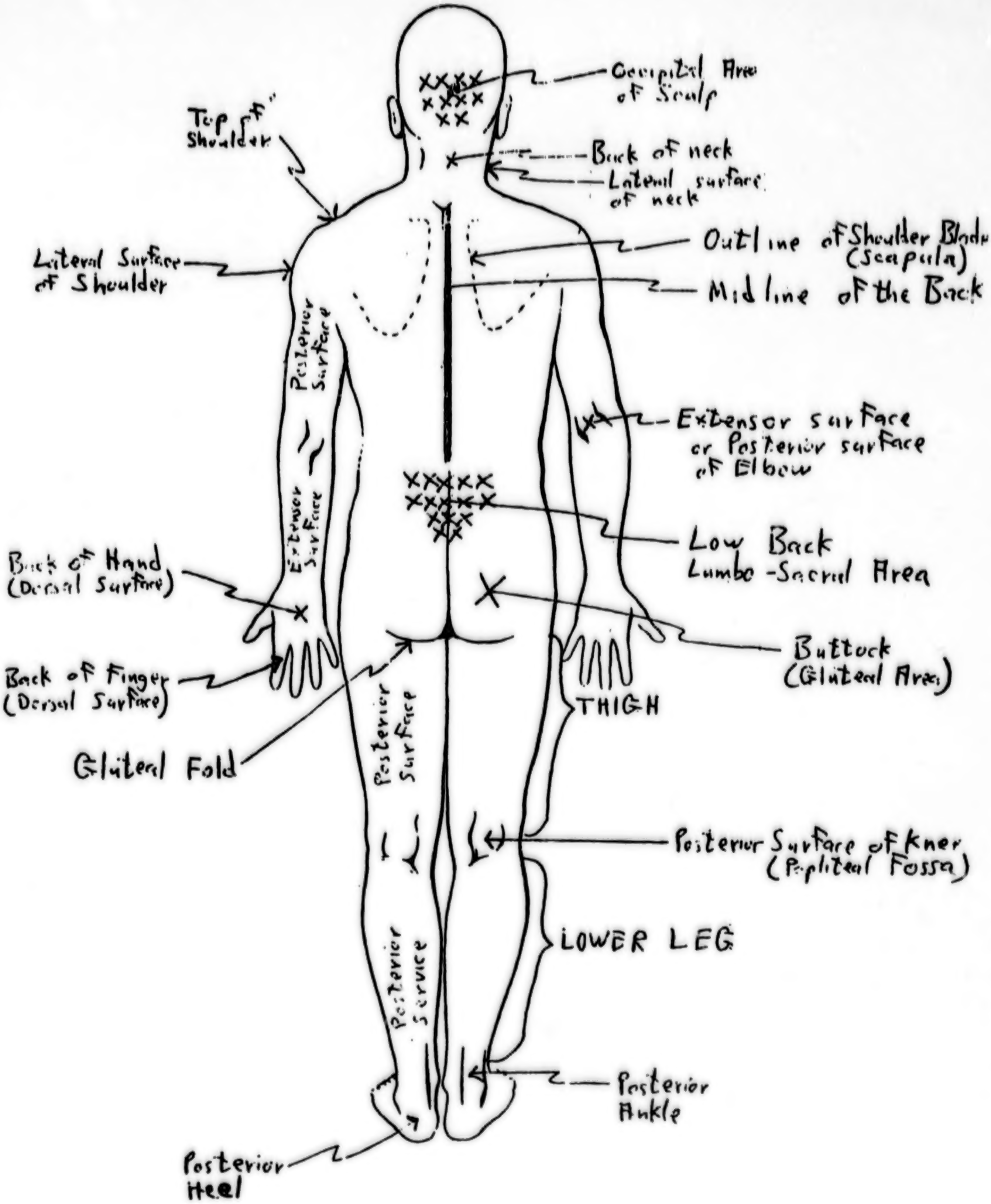
# ANATOMY FOR INVESTIGATORS

BRIAN D. BLACKBOURNE, M.D.

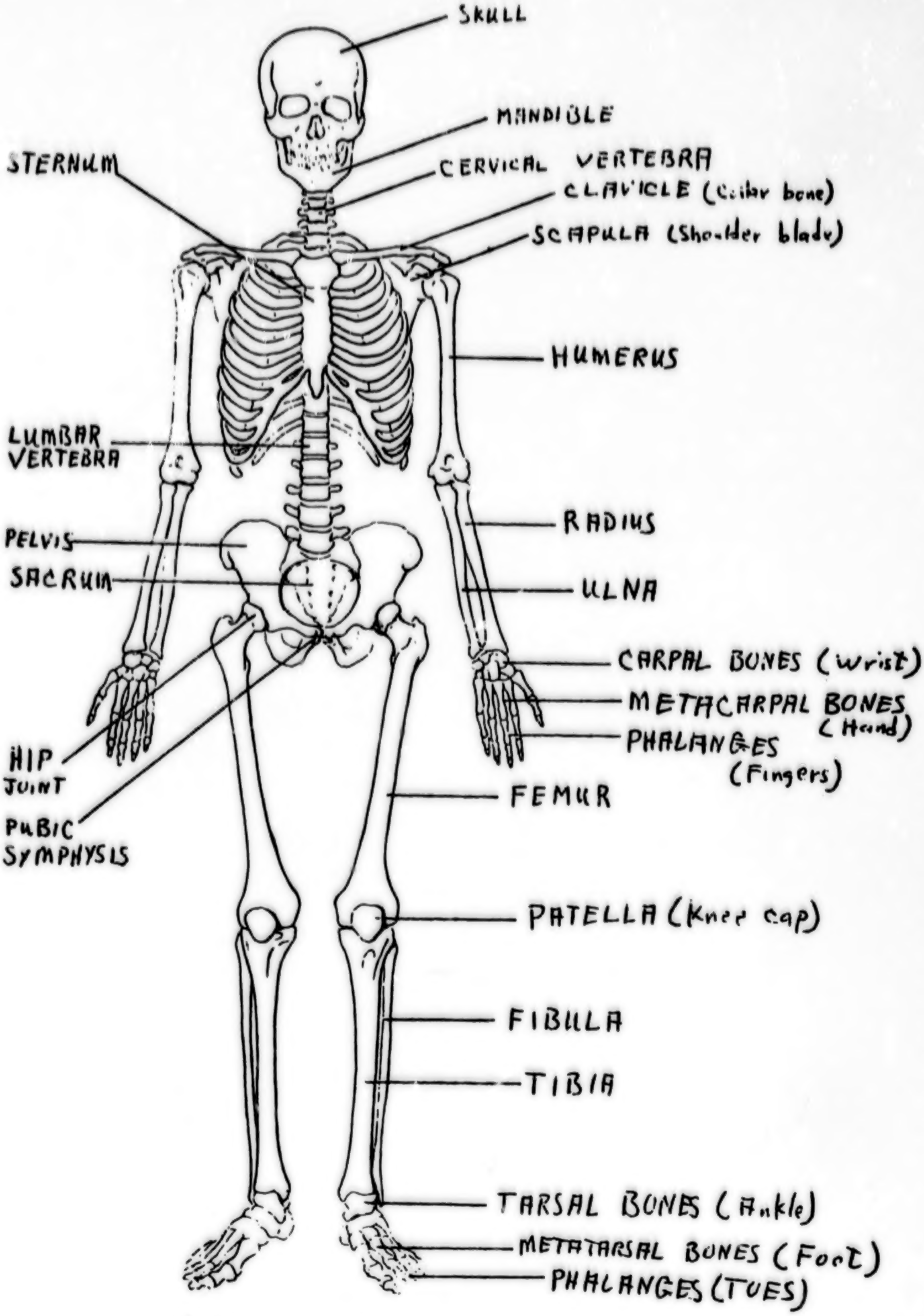
F.B.I. ACADEMY



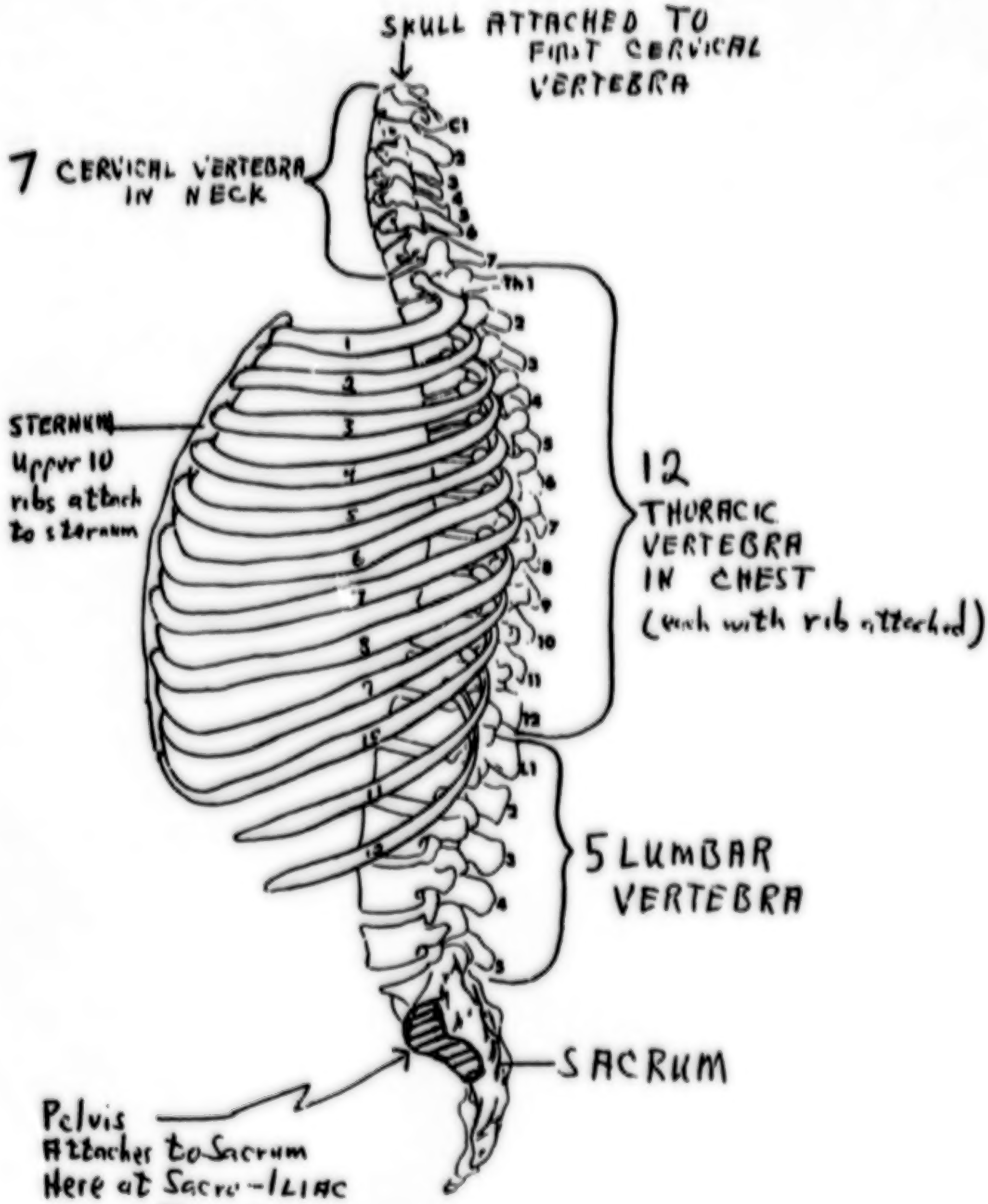

Surface Anatomy Anterior




SURFACE ANATOMY POSTERIOR


SKULL
MANDIBLE
STERNUM
CERVICAL VERTEBRA
CLAVICLE (Collar bone)
SCAPULA (Shoulder blade)
HUMERUS
LUMBAR VERTEBRA
RADIUS
PELVIS
SACRUM
ULNA
CARPAL BONES (Wrist)
METACARPAL BONES (Hand)
PHALANGES (Fingers)
HIP JOINT
FEMUR
PUBIC SYMPHYSIS
PATELLA (Knee cap)
FIBULA
TIBIA
TARSAL BONES (Ankle)
METATARSAL BONES (Foot)
PHALANGES (TOES)

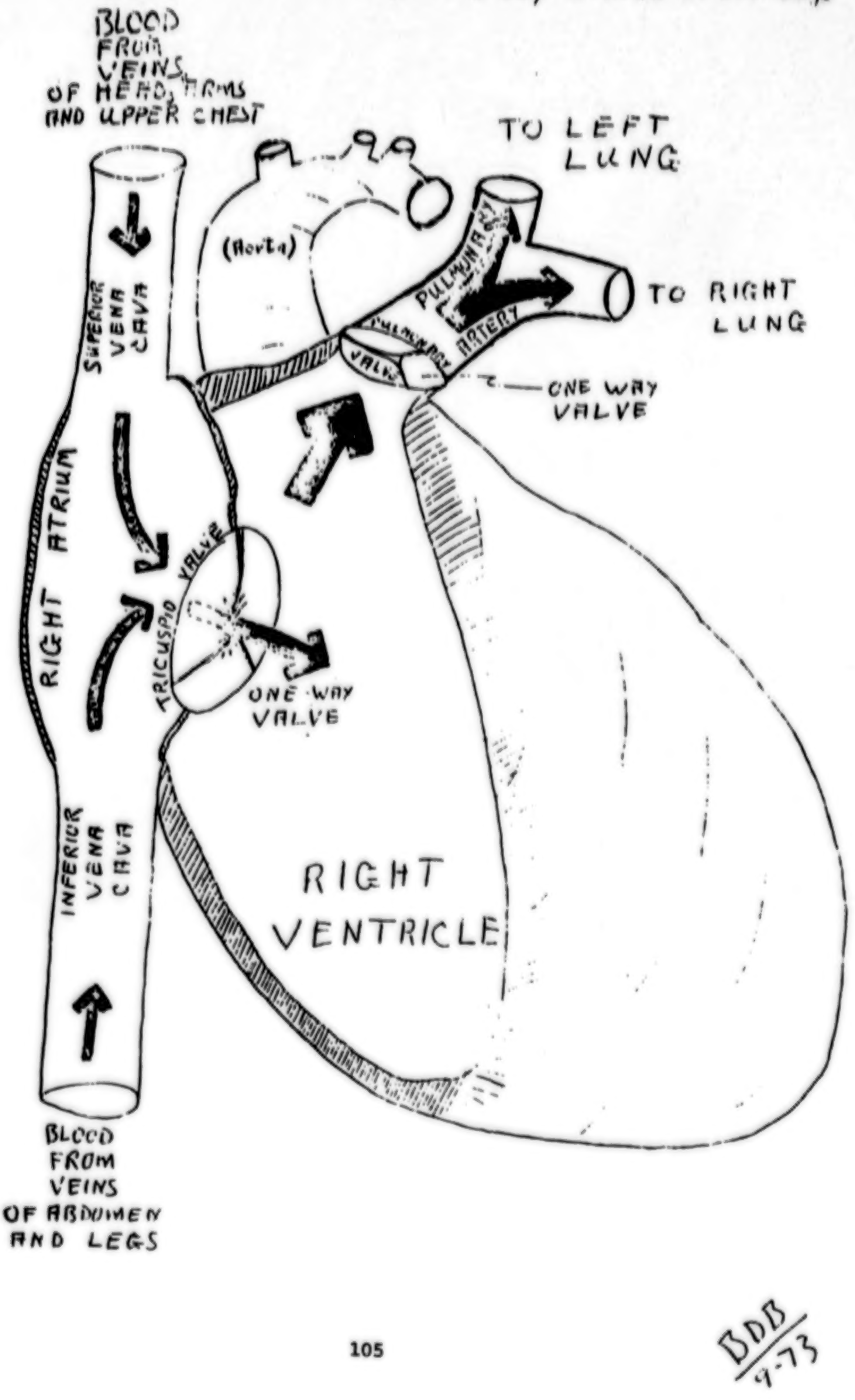
SKELETON



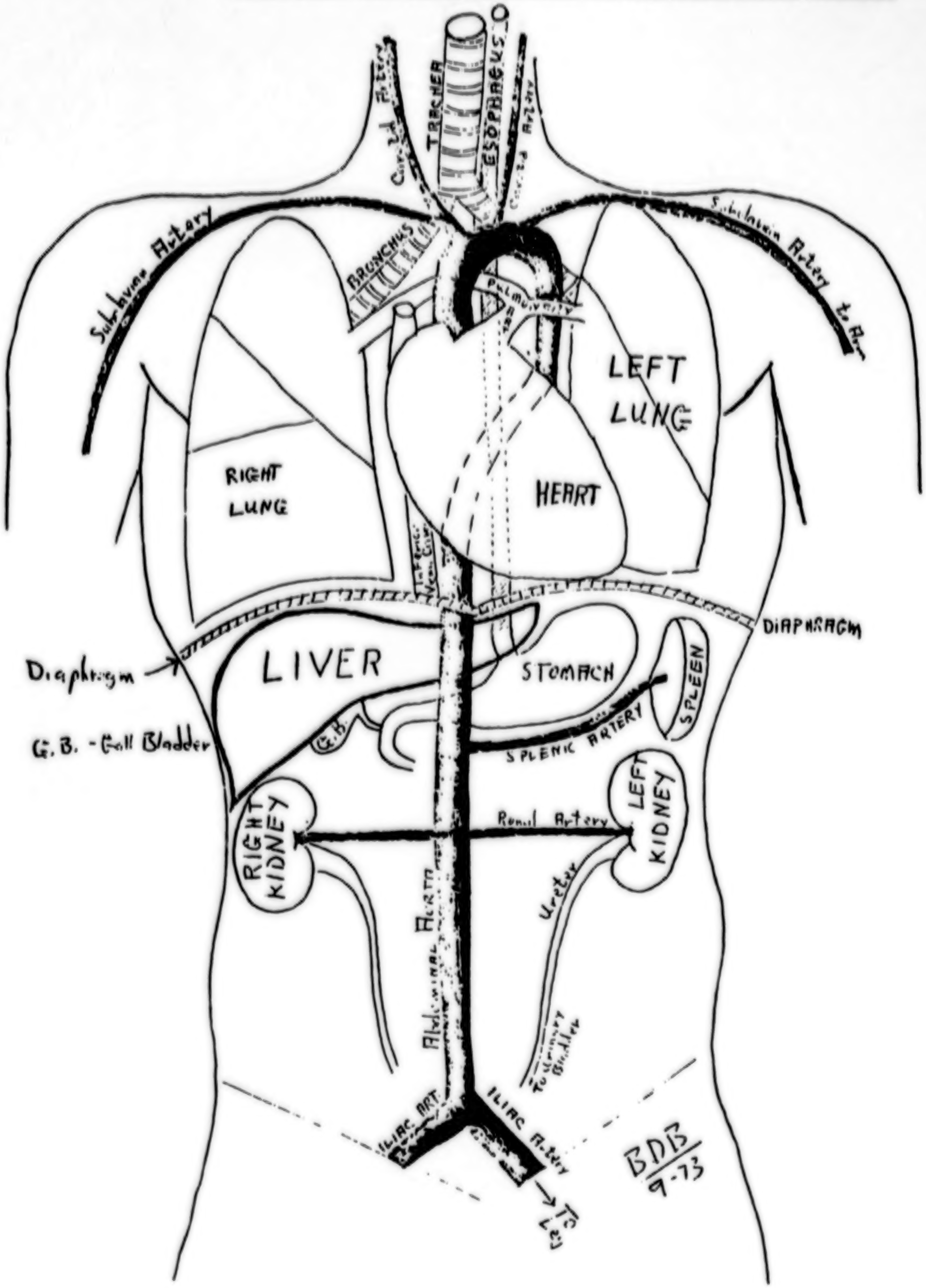
BACKBONE AND RIBS

# THE RIGHT HEART

Blood from the veins of the body travels to the lungs

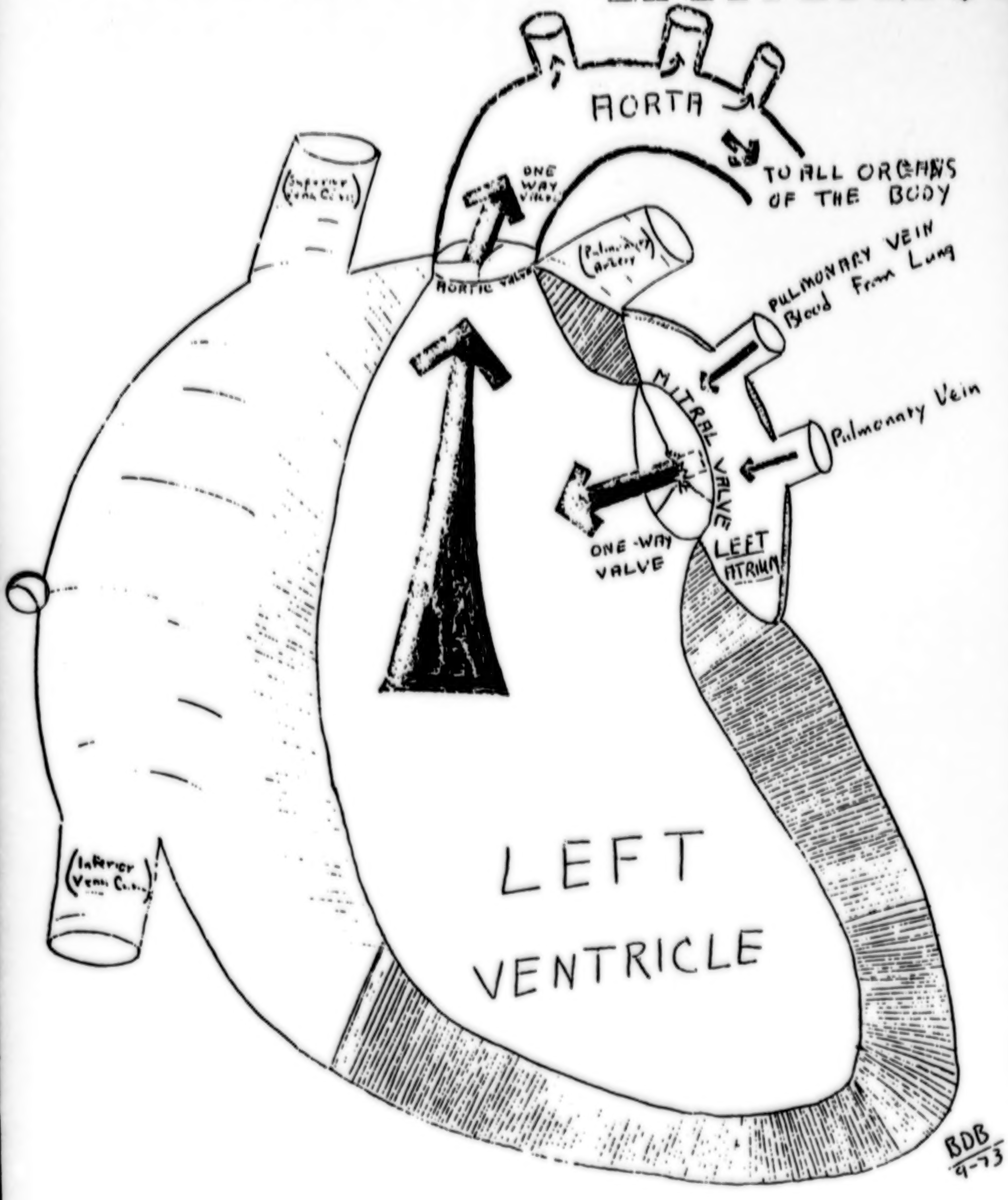


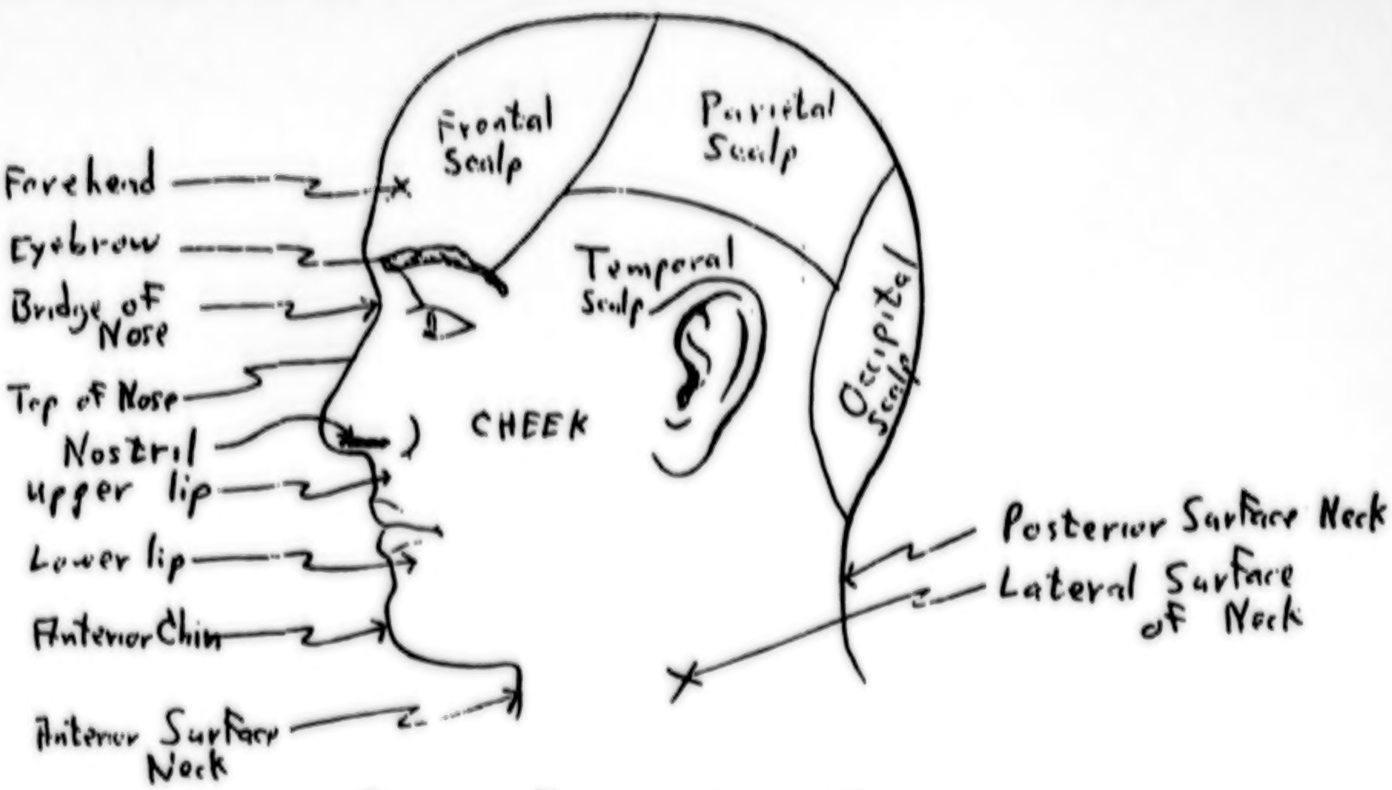
# THORACIC + ABDOMINAL ORGANS



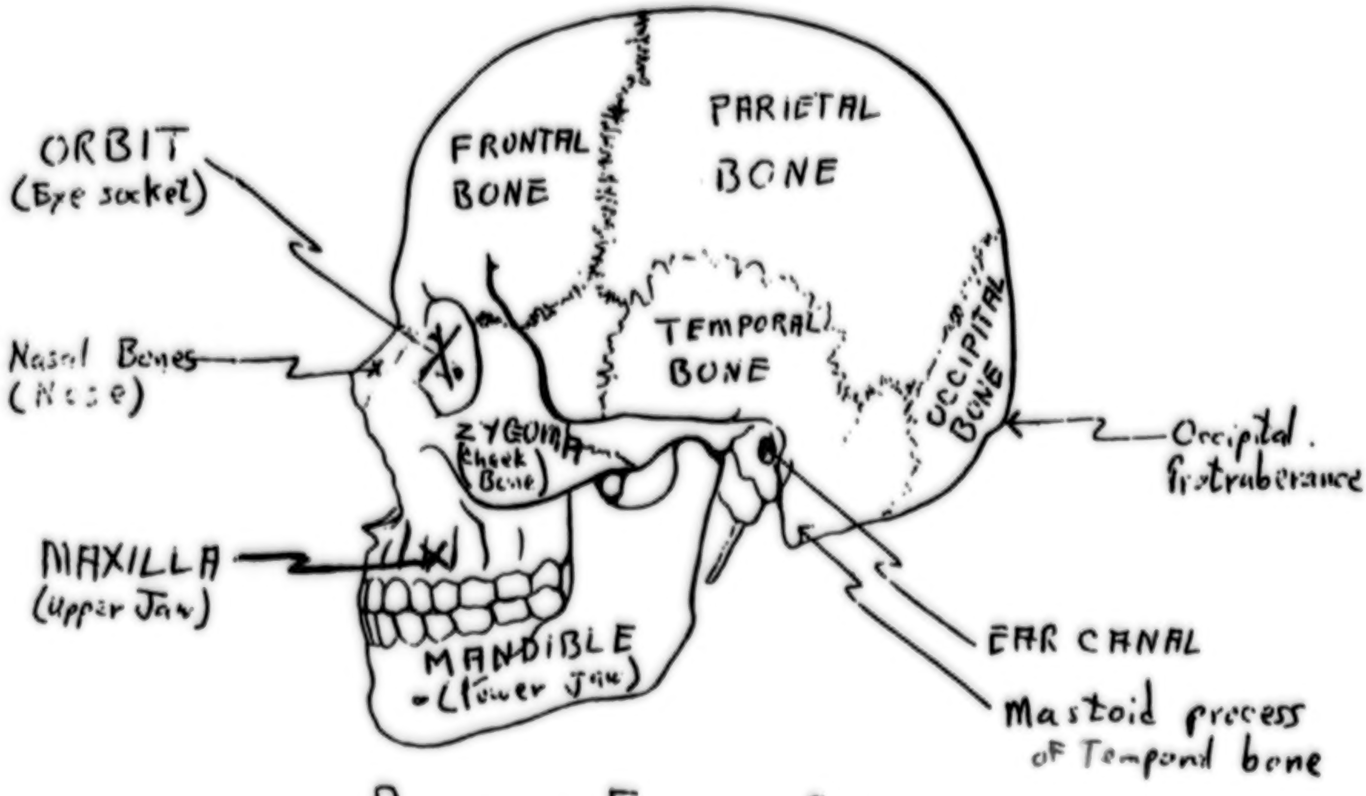
# THE LEFT HEART

Blood From the lungs is distributed to all body organs



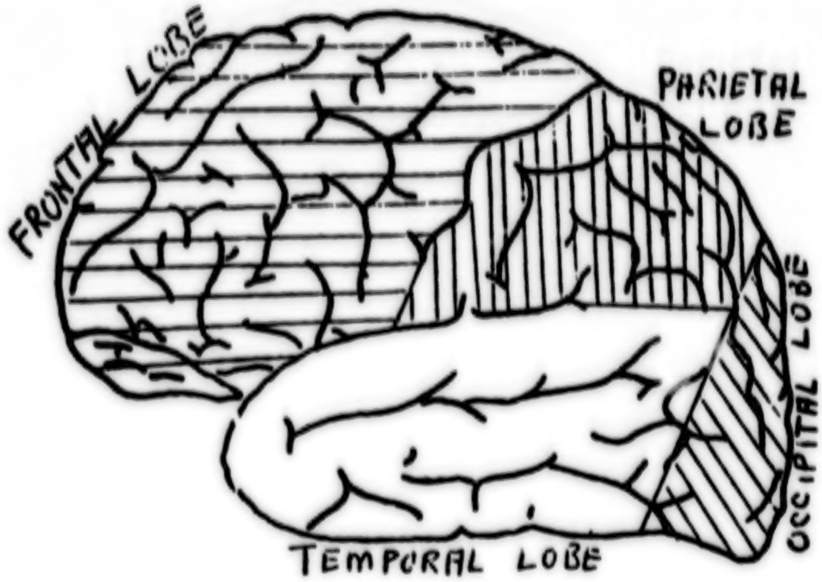



SURFACE ANATOMY FACE & SCALP

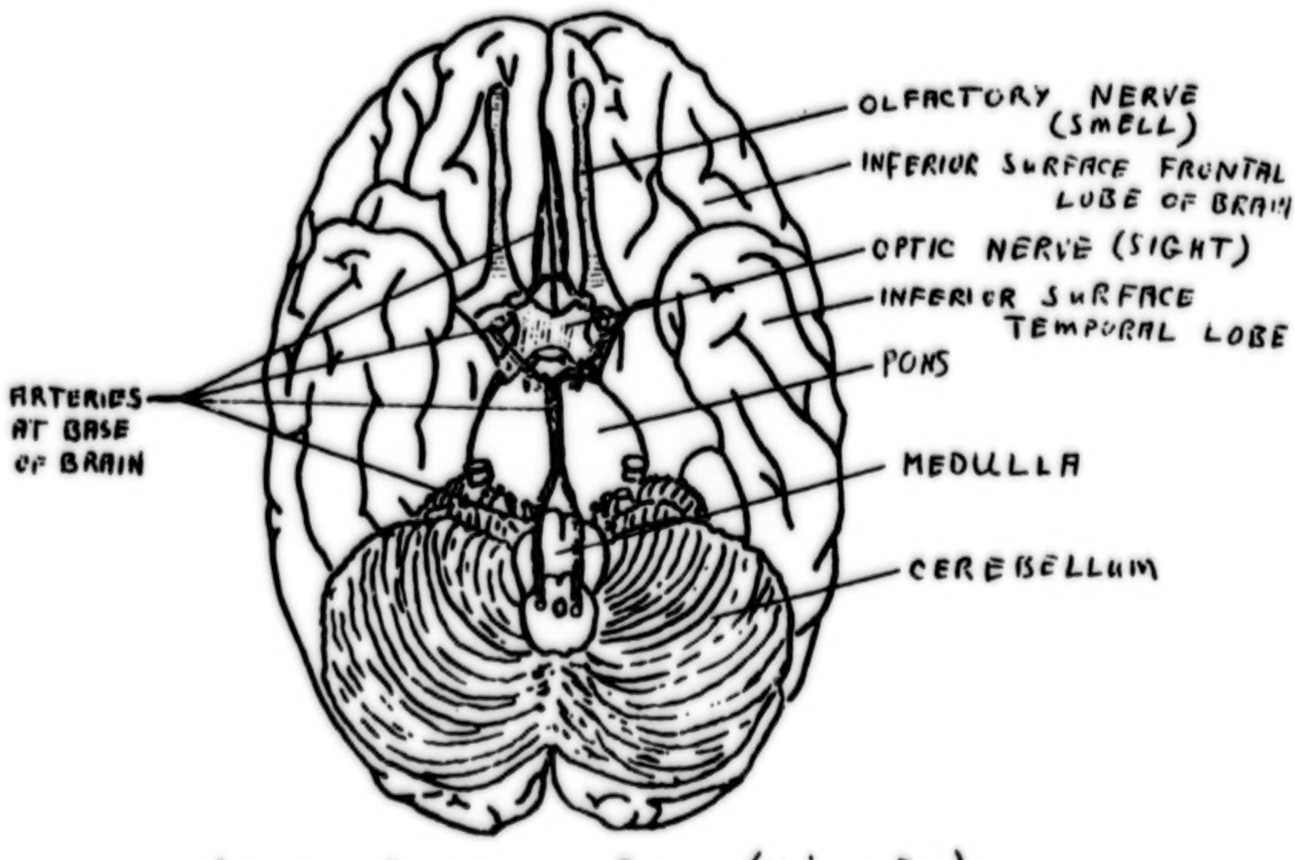



BONES OF FACE AND SKULL

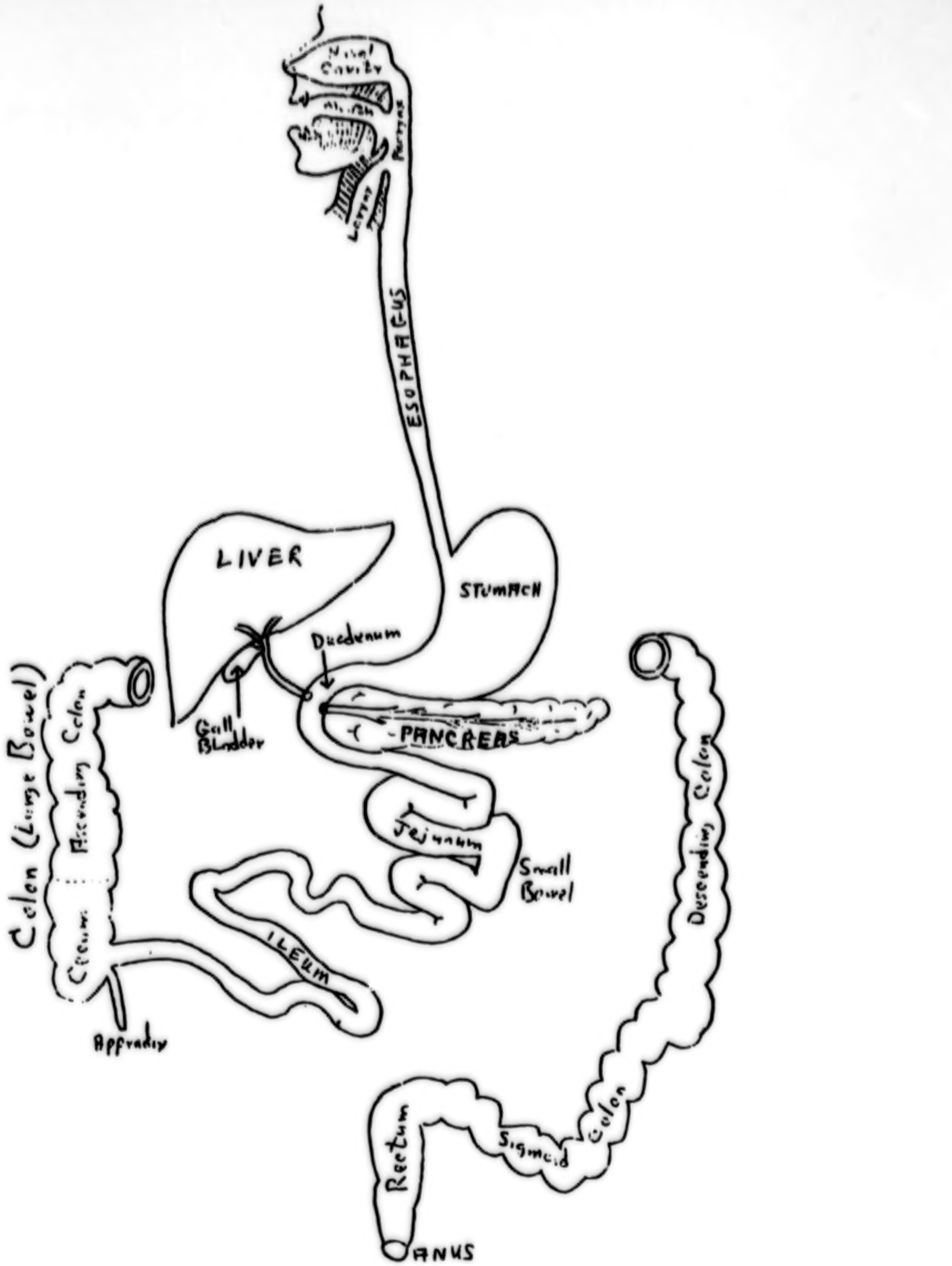
# THE BRAIN



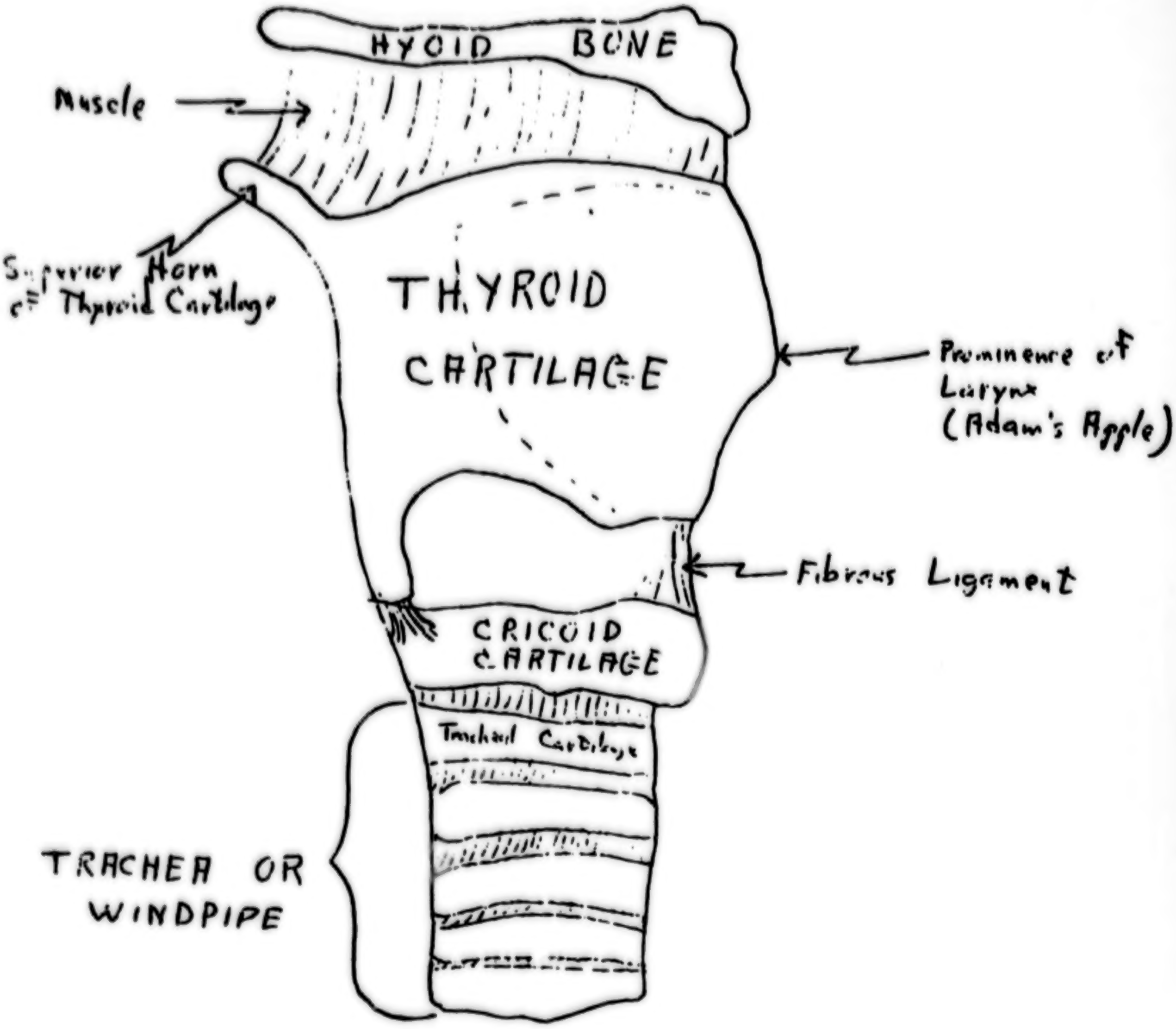

LATERAL SURFACE OF BRAIN (Side View)




INFERIOR SURFACE OF BRAIN (Undersurface)



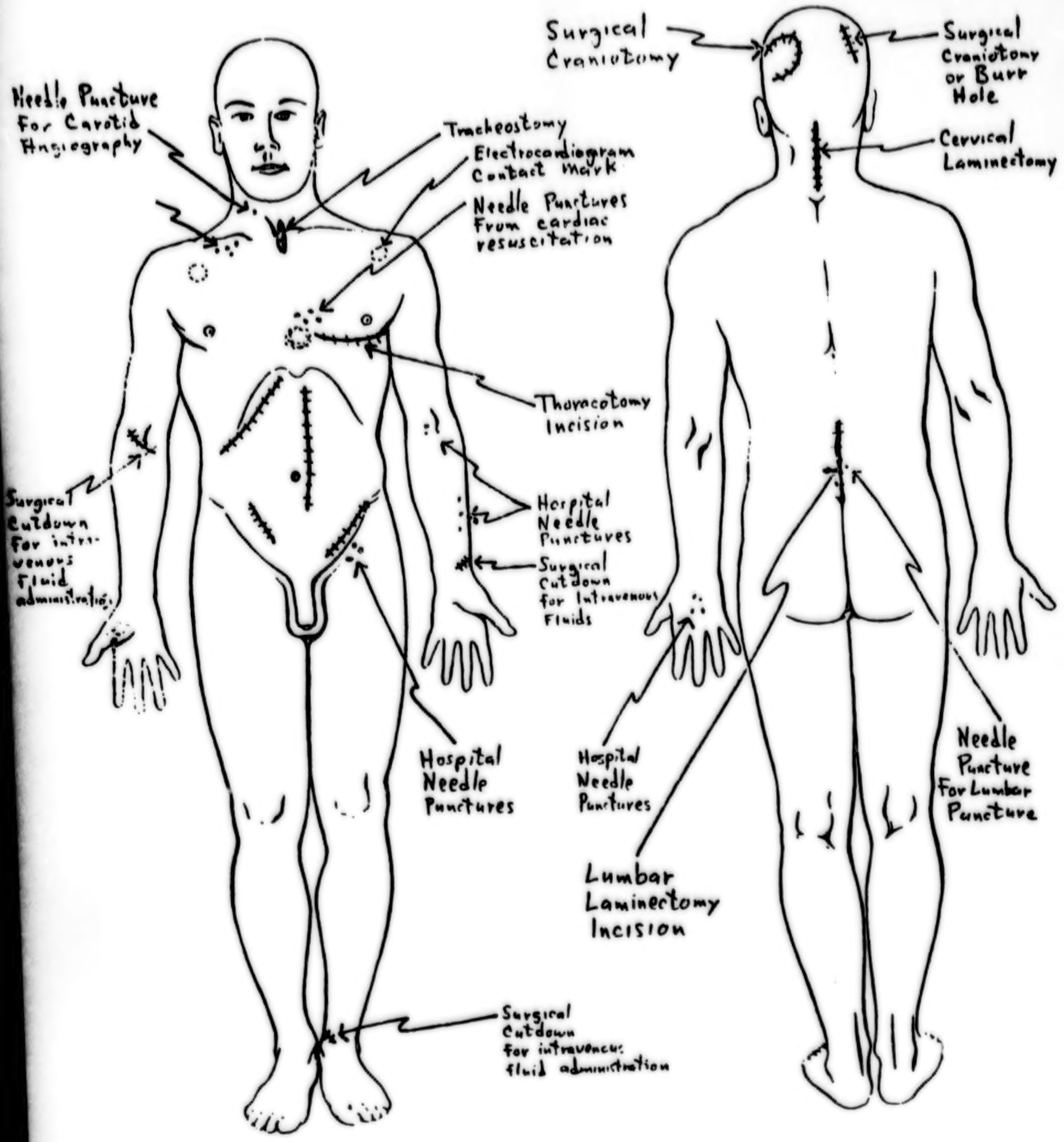

Gastro - Intestinal Track




LARYNX AND TRACHEA

BDB
9-73

## SURGICAL INCISIONS AND HOSPITAL PRODUCED WOUNDS



# Buried Body Cases

By ROBERT M. BOYD*
*Training Division*
*FBI Academy, Quantico, Va.*
**Former Commander, Homicide Squad, Metropolitan Police Department, Washington, D.C.*

The multitude of problems an investigator faces at the scene of an "open" or "mystery-" type murder case is compounded when the unfortunate victim has been buried. These cases are not common, but neither are they so rare as to preclude specialized training and instruction in their proper handling. It is a well-recognized fact that mistakes made during preliminary investigations, especially in murder cases, may well prove fatal to the successful conclusion of the investigation. Although no two murder cases are exactly alike, the basic facts remain the same: The main and possibly the ONLY witness is dead, and the investigation of the case forces investigators to make use of all their talent and training. Part of this talent and training should be directed toward preplanning for crises and recognizing the existence of specialized expert assistance which may be available to provide support.

This article is intended to provide an investigator with useful guidelines and procedures, so that the case of a buried body may be pursued confidently and successfully to the identification and arrest of the perpetrator. Specific attention will be devoted to such critical areas as preplanning, availability of expert assistance, surface processing and excavation of a grave site, removal and examination of a body, visual and aerial techniques in searching, and the use of mechanical aids.

**Preplanning**

One important facet of major case investigations is administrative preplanning, an area that is frequently and unfortunately neglected.

The case supervisor usually is confronted with a series of problems in the initial stage of the investigation, most of them requiring immediate decisions and actions. Quite often, the result is a great deal of confusion, which can hinder the successful completion of an investigation. However, this on-scene confusion can be avoided by good commonsense preparation covering many aspects of the investigation—from having the wherewithal to run a command post in a wooded area to an established written policy dealing with written confessions.

In the instance of buried body cases, this preplanning should include having on call all the various and necessary forensic experts. Such specialists include:

*A forensic pathologist*—one who can interpret and diagnose changes caused by disease and injury and apply them in a court of law (hopefully available to most departments as a medical examiner or coroner's assistant);

*A forensic archeologist*—one who can make a scientific study of material remains (fossils, artifacts, and monuments) and cultures of past human life and activities;

*A forensic anthropologist*—one who can assess skeletal remains and study man in relation to his origin, classification, relationships of races, physical characteristics, social relations, and cultures;

*A forensic odontologist*—one who is involved in the medicolegal system, providing assistance in the

(Published by the Federal Bureau of Investigation, U.S. Department of Justice)
Reprinted from the FBI Law Enforcement Bulletin, February, 1979

identification of bodies through dental record examination and also evidence in cases of human bite mark interpretation;

*A forensic toxicologist*—one who deals primarily with poisons and their effect on organs;

*A forensic psychiatrist*—one who can deal with and treat mental, emotional, or behavioral disorders;

*An entomologist*—one who studies insect life; and

*A botanist*—one who deals with the study of plant life.

(The use of "forensic" applied to these medical specialities means the relation and application of medical facts to legal problems or "suitable for a court of law"—simply, legal medicine.)

Obviously, the evidence or crime scene technician, backed up by the criminalistics laboratory, is also a vital member of the team.

By now, it should be evident the investigator does not stand alone in his quest to answer the questions of who, where, when, what, why, and how.

In all murder cases, the investigator (or detective) is and should be in complete charge of the case, fully bearing the responsibility for any success or failure of the investigation. Notwithstanding this fact, however, the case should be a joint effort, with all those specialists mentioned being involved and sharing equally in the successful conclusion.

## Discovery

A number of cases involving buried bodies develop as the result of a body being accidentally found without prior knowledge or a suspicion that a body existed at that location. Occasionally, information is received that a body is buried and a location is given; these cases will be considered later.

The first duty of an officer responsible for such a case is to establish a list of priority items, despite pressures from both within and without the department. Do not allow yourself to be rushed or misdirected away from the proper and orderly procedures that should be followed. Upon notification of a body's discovery, attempt to ensure the entire scene is safeguarded, before your arrival if possible.

Generally, a hunter, passer-by, or construction worker will find the buried body and notify a police agency, whose representatives will respond to the scene. The entire area should be cordoned off, as with any scene, and access refused to *anyone* prior to the arrival of the investigator in charge, who can appraise the situation before any damage is done.

If the body has not already been removed from the burial site, an archeologist should be called to the scene, as well as a forensic pathologist and evidence technician.

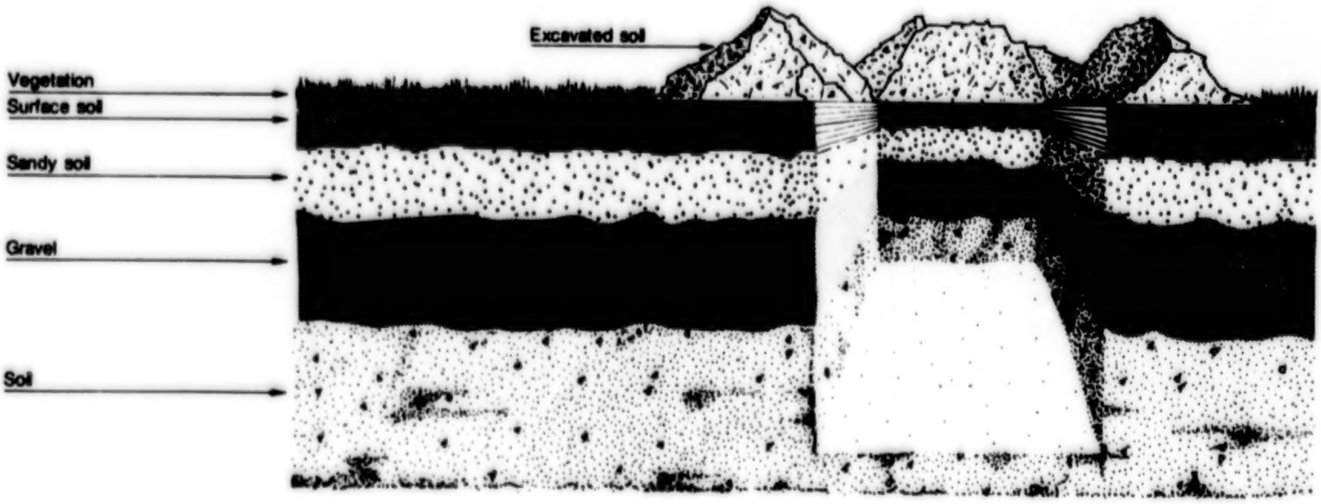
This example of preplanning is a critical element; these experts should have been contacted previously and contingency plans formulated so they will be on call when the need arises. Generally, these doctors look with enthusiasm toward such an opportunity, especially when the crime scene remains undisturbed.

The archeologist is proficient in the careful and systematic excavation of a burial site. Most of this phase of the investigation—the excavation—should be left to his direction, while others of the team assist as necessary.[1]

The forensic pathologist is the expert most familiar to law enforcement officers, and his work is becoming more prevalent throughout the country as a replacement for the coroner. He can provide valuable and impartial expertise when investigating the various forms of death.

Unless some extremely unusual or exigent circumstances exist, there is generally no need to hurry at this stage. If, for example, the weather is inclement, post guards about the area and wait for proper conditions. If there

*Figure 1.* **Site Prior to Excavation** **Burial Site**



is a need for immediate excavation, the erection of a tent over the site should be adequate. (This item should be included in preplanning equipment.) The same rule would apply during hours of darkness. Nothing is to be gained and all may be lost by a premature excavation. After the area is secured, all team members assembled, and plans completed, then the actual work may commence. The golden rule of homicide--"Never move, touch or alter anything until it has been noted, sketched and photographed"—is especially applicable in this type of case.

Prior to a thorough search and processing of the area, the entire site should be mapped. This would usually be done by the crime scene examiners who would draw plan views of the area to a workable scale with tie-ins to permanent landmarks. Then the search may continue, both visually and with mechanical assistance (metal detectors, etc.), and any items noted, sketched, and photographed.

Photographs should be taken of the entire area, including aerial views if possible. The team can then move in slowly to the actual site. Photographs, in both black and white and color, are to be taken at intervals up to and including the actual burial site. If possible, as with any discovered body, determine the path taken to the site by the finding party, mark it, and then use *only* this way in for the initial investigation in order to preserve as much of the general area as possible. The photographer should be accompanied by the crime scene technician or investigator who can note and preserve any item of evidentiary nature on the way to the site—tire tracks, articles of clothing, possible weapons, or *anything* that might possibly be connected to the crime.

Photographs should *not* include any persons standing around the scene, or any items not originally located there, such as camera boxes, etc. At the same time, any item of evidence that has been moved, either accidentally or by mistake, must never be replaced for purposes of photographing. It can never be put back exactly the same way as found, and the fact it was moved and replaced for photographing could be damaging in subsequent court testimony. Items should be photographed with and without identifying numbers, a scale, and an arrow pointing to magnetic north.

The definition of the term "site" is important in the buried body case. When a grave is dug and the excavated soil is placed near the grave, the surface of the soil is disturbed, so that the grave "site" is considered to be the entire disturbed area. Thus, if an average-size body were to be buried, the entire site of grave and disturbed section would easily measure 6 feet wide and 8 feet long. The depth of the excavation is generally dependent on the soil composition and the amount of time the subject had to spend at his task.

When the excavated soil is placed on the surface, vegetation may be compressed and/or broken off. When the grave is refilled, some of this surface vegetation will go back into the grave. (See fig. 1.) Here another expert may come to your aid—the botanist who can provide estimations as to how long the vegetation has been damaged by observing the height, distribution, and depth of root systems involved at the site. If a botanist is not available, measurements and samples should be taken for later study. Damage done by digging and refilling a grave may be visible and measurable for years, when compared to adjacent normal and undisturbed growth. If any dead insects are recovered from the grave, an entomologist may give information to their life span, activities, etc. Maggots, if present, will be included in this examination. An examination of their type, life cycles, etc., may enable the entomologist to give a minimum time span

**Refilled Site**

on the time of death. Samples of the fly larvae should be taken at each life stage found. These specimens can be placed in a solution of 85 percent alcohol for preservation while they are transported to the examiner.

### Excavation

The surface of the grave should now be carefully cleared of extraneous material so that the boundary of the actual grave may be visible. This should be done with tools such as a flat-bladed spade or hand trowel. Then the dimensions should be recorded on the map and excavation begun.

Extreme care should be taken to preserve the exact limits of the original grave or the undisturbed remains, if part of the site had been damaged during the discovery. When the soil had been removed originally and then thrown back into the grave, the various layers and compositions of soil and vegetation became mixed or mottled (as illustrated). Slow and careful removal of this material may reveal the toolmarks made on the outside edges; it may even show the type of blade involved, whether curved or straight, with enough definitions to make toolmark identification later on a suspected shovel or other tool.

Prior to actual excavation, and after the photographs have been taken of the burial site in original condition, additional maps should be made of the site to show both plan and elevation views of the grave and to tie in items found both by horizontal location and depth. (See figs. 2 & 3.) Expert help may be available through a county or State highway department engineer or surveyor, who would have all the tools necessary to do the job properly. (Items such as a compass, plumb bob, string, protractor, and string level are necessities.)

The soil should be removed in somewhat even layers, such as 4 to 6 inches, and all removed material sifted through two screens. The first screen should have ¼-inch squares; the second should be a standard window screen. As items are located and recovered, they should be plotted on the elevation or side view of the drawings. The completed drawing can then accurately reflect the various vertical levels of such items in the grave, as the plan view will indicate their horizontal distances apart. For comparison, soil samples should be taken where each item is recovered, and each should be accurately documented. Keep in mind items recovered may still bear latent fingerprints.

### Body

When the body is uncovered and has tissue remaining on it, the forensic pathologist may make a cursory examination on the scene. When this examination is completed and photographs taken, a freshly laundered or new sheet should be available and the remains carefully placed in it so as to preserve any evidence not immediately visible but which might be lost in transit. Next, fold the edges over and place the sheet in a body bag or container for removal to a proper place of autopsy (hopefully a well-equipped and lighted morgue). The sheet, together with any other physical evidence, will be separately marked for identification, packaged, and handled following proper and proven procedures, as outlined in Part IV of the FBI Handbook of Forensic Sciences.[3]

After removal of the body, the grave should again be photographed and the area under the body carefully searched and excavated several more inches. A metal detector will be useful here if bullets were fired into the body after it was placed in the grave or if other metal objects are hidden in the soil.

As previously mentioned, if a body is recovered with soft tissues present, the forensic pathologist should conduct an autopsy. This post mortem examination, using blood and body fluid analysis, stomach contents, X-rays, and other routine procedures, may reveal the cause of death, an estimation on the time of death, antimortem and post mortem wounds, possible weapons used, identification of the decedent, and other essential information necessary to successfully investigate the case. The pathologist may be joined in his efforts by the odontologist and toxicologist, plus the resources of the crime lab and records section.

A badly decomposed body is no reason for despair, as many things can be learned from what appears to be the hopeless caricature of a human being.

If the remains are primarily human skeletal, then a forensic or physical anthropologist is needed. The anthropologist is best equipped to provide the following information:

*Sex*—Critical bones for sex determination are the pelvis, skull (85 percent accurate), femur, and sacrum;

*Age*—Critical bones are the pelvis, teeth, skull, and long bones (age determination becomes difficult once a person is past 25 years);

*Ethnic group/race*—Skull and teeth are good indicators; and

*Stature*—Critical bones are the femur, tibia, fibula, humerus, radius, and ulna.

It should be noted there are certain limitations in assessing skeletal remains. Primarily they are as follows:

*Estimated time of death*—With so many variables, it is generally possible to set only broad time limits;

*Cause of death*—Not generally registered on skeleton, but signs found may be post mortem;

*Reconstruction of facial soft tissue*—An area under study today, which shows promise but is not yet fully developed;[4] and

*Medical histories*—May show old fractures, dental work, back problems, etc., but this source of information is limited. It is important to remember an anthropologist *cannot* date *time* of death within a useful time frame, or give *cause* of death.

It is obvious that law enforcement personnel cannot receive the extensive training in skeletal anatomy necessary to make expert analyses of suspected human bones. But some instruction may be provided by physical anthropologists so as to enable officers to screen out animal remains from human. Many cases are reported to agencies in which the finder of some bones incorrectly believes them to be

*Figure 2.*

**Plan View of Site**

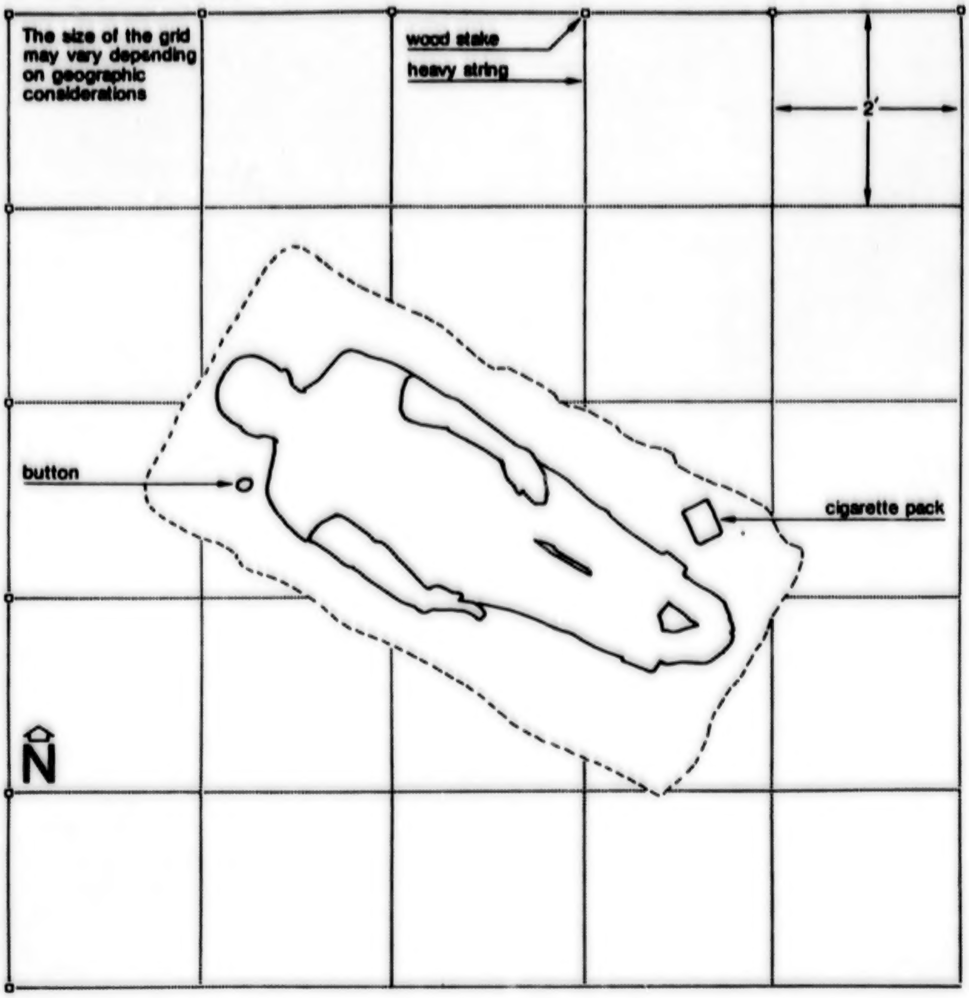



Illustration of lanes laid out in north-south direction.

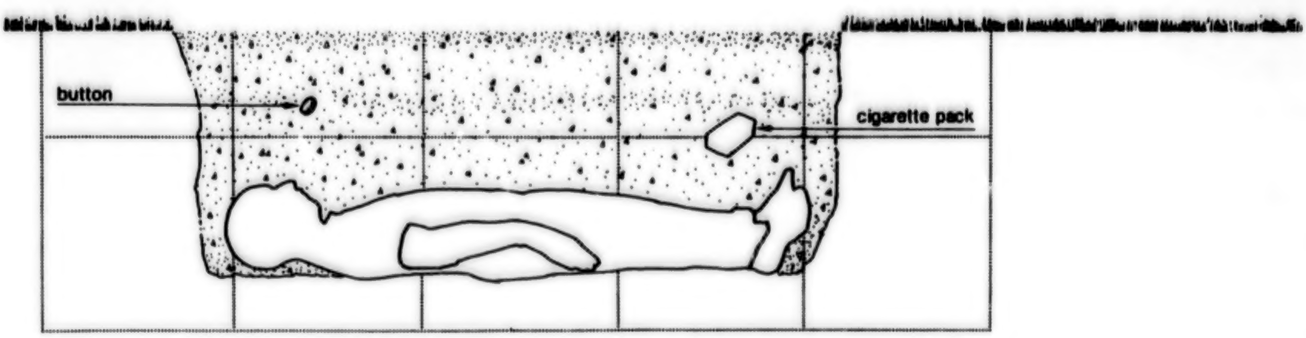
Then a cross-grid is laid out when body is located.

Smaller grids may be used when small objects are found in the grave.

*Figure 3.*

**Elevation View of Site**

Photograph items of evidence with ruler and north indicator



"The ultimate goal is to recreate as accurately as possible the circumstances of the crime . . . and successfully guide the case through the criminal justice system."

human, either of historic interest or a murder victim. For example, the paw of a bear in skeletal form closely resembles a human hand, but with some training the difference is readily apparent even to a layman.

**Search For A Buried Body**

In some cases, information is received through an informant, citizen, or by means of a confession that a body has been buried and an approximate location is given. The grave site may be identified precisely, or an area as small as a city lot or as large as several hundred acres indicated. In either case, again, it is critical to establish quickly security around the entire suspected area to prevent access by unauthorized persons.

Good planning is vital. The more known about the circumstances of the crime and burial, the greater your chances are of locating the site. For example, if it is known or believed the victim was killed elsewhere, then the grave may not be too far from a road. However, if the killing was alleged to have taken place at the site, then the victim could have been made to walk a considerable distance. The time interval since the killing occurred will have a bearing on the condition of vegetation around the site, as well as the actual grave itself, as the grave may have sunk or the surplus dirt may still be in a mound. Again, a botanist can give approximations on damaged plant life which had revived and started growing again. Areas of sparse vegetation will be difficult to estimate due to the lack of growth, but buried insect life may still be useful. A similar problem may be encountered where the surface has been cultivated; the only visual indicator of a grave may be a depression in the surface after some time has passed.

An aircraft, especially a helicopter, may be used prior to a foot search to observe visually a sign of soil or vegetation disturbance. Much progress has been made in the use of thermal infrared photography, which may be of some aid in these cases. Infrared film detects heat—a decomposing body emits heat as tissues begin to rot. However, if the infrared photography is used very soon after a body has been buried, or an extended period of time has passed, then heat is no longer being generated and nothing would be shown on film.

Aerial photographs should be taken of the area both prior to a search, and if the search is successful, at the conclusion.

When it becomes necessary to conduct a foot search in a suspected area, mechanical aids become essential, especially if a visual search has been negative. Probing is the first step. This is done with a steel rod, preferably stainless steel, approximately 5/16 inches in diameter and 4½ to 5 feet long. A "tee" handle is welded to one end, the other end ground to a sharp point; the success of probing depends on an ability to detect the difference in the disturbed and undisturbed subsurface soil. Some practice is desirable in the immediate area by the persons probing to get a "feel" for the type of soil in that region.

Prior to the start of actual probing, the coordinator of the search must formulate his plans carefully by having a map of the area, making a grid overlay tied into known landmarks, and preparing lanes with stakes and string for the searchers. In areas of woods or heavy underbrush, the establishing of grids is more difficult, and the case coordinator/supervisor will have to be especially watchful so as to avoid any locations not being checked properly. The area should be probed in not more than 2-foot squares and done in a staggered pattern.

As probing is difficult and requires the use of "new" muscles, care should be taken to plan for shifts of searchers and frequent rest periods. (The coordinator must also keep his map posted on the search area that has been completed.)

When a "soft" spot is located, indicative of a possible grave, the probe should be left in the ground, and no further probing done to the area since damage to the body could result. At that point a second mechanical aid is employed—an instrument which is capable of verifying the presence or absence of a body without the need of excavating. One such instrument, using methane gas as a primary source of verification, operates on the detection of hydrogen sulfide, hydrogen phosphide, carbon dioxide, ammonia, and methane gases formed by a decomposing body.

The gas formation is minimal at low temperature, 32 degrees to 35 degrees, but as the ground would be frozen also, probing would not likely be attempted. In warmer temperatures, the gas forms and may be detected by the gas-sensing probe.

After a suspected site is located, a temperature-sensing probe is inserted in the site and a reading taken so as to set the gas instrument to the correct sensitivity. The vapors from the gases of a buried body will penetrate the soil upward in a V-shape, with the greatest concentration directly over the body. A probe inserted beside a body or too

deeply could therefore miss the gas area. Consequently, several probings are made at different depths to ensure complete coverage. (See fig. 4.) This probe can be an invaluable aid in checking suspected areas without an excavation at each one. It can also be used to check under concrete—roadways, patios, floors—after a small hole is drilled through the concrete. This instrument or one of similar design and/or capabilities should be a part of a crime lab's equipment, especially where rural areas are included in the jurisdiction.

The discovery and excavation of a buried body is a challenge to law enforcement, taxing abilities and patience and requiring a firm control over the entire investigation. There is no place in these cases for the investigator who wants to be the "whole show," lacks training, and is ignorant of available resources. Expert help should be utilized if at all possible. Generally, a delay in initiating the crime scene processing in order to marshal necessary resources may insure a more successful investigation.

Remember that the ultimate goal is to recreate as accurately as possible the circumstances of the crime committed, identify and apprehend the perpetrator(s), and successfully guide the case through the criminal justice system. FBI

**Footnotes**

[1] William M. Bass, Ph. D. and Walter H. Birkby, Ph. D., "Exhumation: The Method Could Make The Difference," *FBI Law Enforcement Bulletin*, Vol. 47, No. 7, (July 1978) pp. 12–15.

[2] Available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 (Price $2.00).

[3] Donald G. Cherry and J. Lawrence Angel, Ph. D., "Personality Reconstruction From Unidentified Remains," *FBI Law Enforcement Bulletin*, Vol. 46, No. 8, (August 1977) pp. 12–15.

**Acknowledgments:**

*Florida Department of Criminal Enforcement Training Bulletin*, May 1976.

Morse, Dan, M.D., Crusoe, Donald, Ph. D., and Smith, H. G., Ph. D. "Forensic Archaeology," *Journal of Forensic Sciences*, Volume 21, No. 2, (1976), pp. 323–32.

Scott, Dr. G. Richard, Anthropology Program, University of Alaska.

**Recommended Reading**

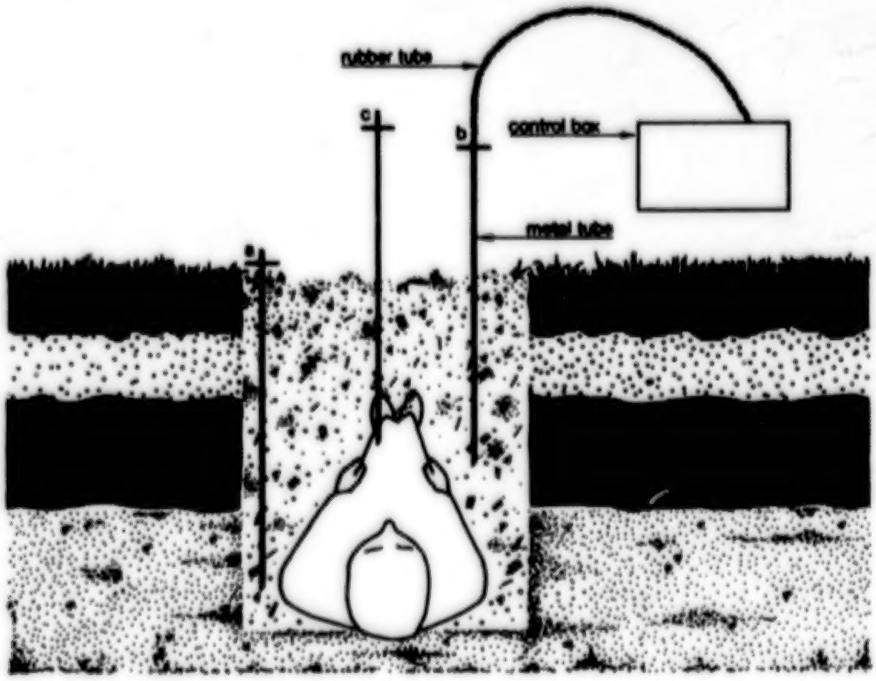
Comas, Juan.
*Manual of Physical Anthropology.* Springfield: C. C. Thomas, 1960.
Hester, T. R., Heizer, R. F., and Graham, J. A., Eds.
*A Guide to Field Methods in Archaeology.* Palo Alto, Calif.: Mayfield Press, 1975.
Montagu, M. F. Ashley.
*Introduction to Physical Anthropology.* Springfield: C. C. Thomas, 1960.

*Figure 4.* **Vapor Detector**

(a) Missed vapors — too deep

(b) Not directly over body but shallow enough to catch vapors

(c) Directly over body — strongest vapors



# IDENTIFICATION

Charles J. Stahl, M.D.
Captain, MC, USN

## I. Introduction

A. The identification of unknown human remains is based upon comparison of known information derived from records with data obtained by examination of the victims.

B. The consultative assistance of other forensic scientists, particularly physical anthropologists, dentists, radiologists, criminalists and serologists, is often required for conclusive identification.

C. The following records are useful for comparison with the investigative and postmortem findings:

1. Reports of missing persons.
2. Fingerprints.
3. Dental records.
4. Health records, including past medical history, physical examination, and operative reports.
5. Laboratory records, including blood group and type.
6. Antemortem x-rays.
7. Employment records.
8. Police records.

D. The medical examiner, or the coroner, has the responsibility for the determination of the cause and the manner of death, as well as for the identification of unknown human remains and the estimation of the time of death.

E. Accurate identification of unknown human remains is required for the following reasons:

1. Completion of official records.
2. Notification of the next of kin.
3. Settlement of estates and insurance claims.
4. Establishment of the corpus delecti after homicide

F. Applications of procedures for identification.

1. Antemortem identification.
   a. Comparative identification of wanted criminals, or missing persons.
   b. Identification of criminal suspects by bite marks.
   c. Attempts at interchange of identity.
2. Postmortem identification.
   a. Identification of single individuals.
      (1) Unknown, decomposed, mutilated, skeletonized or incinerated remains.
      (2) Establishment of corpus delecti after homicide.
   b. Identification of mass casualties.
      (1) Accidental deaths: fire, explosion, vehicular accidents, aircraft accidents.
      (2) Military operations.
   c. Identification of remains after mass burial, or after exhumation of single individuals.

G. Objectives of the medicolegal investigation

1. Are the remains human or non-human?
2. If the remains are human, what evidence is available to determine the estimates of age and living stature, as well as the sex, race,

and individual characteristics of the remains?

3. Based upon the investigative and postmortem findings, is it possible to provide an estimate of the time of death and/or the duration of time between death and the discovery of the remains?
4. What is the cause and the manner of death?
5. Were any injuries sustained after death?
6. Is there any indication of interchange of physical evidence between the victim and an assailant?

II. Preliminary Steps

A. On-the-Scene investigation.
   1. Establish a perimeter about the scene to prevent disturbance of the remains and the physical evidence.
   2. Maintain security for the area and require identification procedures for personnel entering the area.
   3. Establish and maintain a chain of custody for all physical evidence.
   4. Consecutive numbers for bodies.
   5. Provide a system for communication between investigators on-the-scene and central offices.
   6. Maintain the relationship between clothing and personal effects found at the scene and the respective remains.
B. Determine jurisdiction for investigation.
   1. State or local jurisdiction
      a. State, or local law enforcement agencies
      b. Medical examiner, or coroner

2. Federal jurisdiction (Federal Aviation Act of 1958).
    a. Federal Aviation Agency (FAA).
    b. National Transportation Safety Board (NTSB).
    c. Federal Bureau of Investigation (FBI).
    d. FBI Disaster Squad.
3. Military jurisdiction
    a. Commanding officer of nearest military installation.
    b. Judge Advocate, or legal officer, or nearest military installation.

C. Determine special requirements for facilities and assistance
1. Communications.
2. Consecutive numbers and disaster bags for remains.
3. Transportation to remote areas.
4. Facilities for postmortem examination and preservation of remains.
    a. Rental of refrigerated vans.
    b. Building suitable for temporary morgue.
5. Laboratories for examination of physical evidence and/or completion of toxicologic studies, depending upon jurisdiction.
    a. State or local crime laboratory.
    b. Medical examiner, or coroner.
    c. FBI Laboratory.
    d. Army CID Crime Laboratory
    e. Military hospital or area laboratory.
    f. Civil Aeromedical Institute (FAA) - commercial carrier or general aviation accidents.

g. Armed Forces Institute of Pathology - military aircraft accidents.

6. Consultants

   a. Physical anthropologist.

   b. Radiologist.

   c. Dentist.

   d. FBI Disaster Squad.

   e. Identification Division, FBI - Fingerprints.

7. Support for black and white and/or color photography on-the-scene, as well as during the postmortem examination.

8. Facilities for radiographic studies of remains, including dental x-rays and total body x-rays.

9. Facilities for special studies such as neutron activation analysis.

## III. Postmortem Procedures for Identification

A. Immediate action.

1. Obtain all available records for comparison with the results of the examinations. See I.C. (Comparison = Identification)

2. Obtain photographs of remains, clothing and physical evidence.

3. Obtain selected x-rays, dental x-rays, and/or total body x-rays, as appropriate, for comparison with antemortem x-rays.

4. Obtain fingerprints for comparison with existing records.

5. Obtain samples of hair, blood and/or body fluids for comparison with known samples of hair and results of prior studies for blood group and type.

6. Obtain consultative assistance, as appropriate, for evaluation and interpretation of skeletal, dental, and radiographic findings.

7. Examine, describe, record, and photograph the clothing and other physical evidence prior to release for other laboratory examinations.

8. Review reports of missing persons, statements of witnesses and/or next-of-kin, and contents of passenger mainfests provided by representatives of airlines following mass disasters or aircraft accidents.

B. Methods for Identification

1. Least reliable methods

   a. Personal recognition by relatives or friends.

   b. Clothing - may be helpful in mass disasters.

   c. Personal effects - may be helpful in mass disasters.

2. Scientific methods based upon comparison.

   a. Fingerprints - the most reliable method for identification in the United States since the establishment of a national repository for data by the FBI in 1924. Footprints, ear-prints and lip prints are also useful provided appropriate records, or records prepared from latent prints, are available for comparison.

   b. Dental - the individual characteristics of teeth, compared with dental records and dental x-rays, provide an excellent means for identification, as well as information concerning the age, race, pre-existing disease, habits, occupation, and prosthetic applicances are often resistant to the effects of trauma and heat.

c. Skeletal - bones are often resistant to the effects of environmental conditions and time, as well as the effects of heat. Depending upon the completeness of the skeletal remains, it is often possible to determine the age at death, sex, race, evidence of prior disease or injury, estimate of living stature, and other individual characteristics. Animal bones are distinguished from human bones.

d. Hair - microscopic comparative examination of the cuticular patterns and cross sections of hair are helpful in the determination of race, as well as to identify hair from animals.

e. Serologic and cytologic studies - blood group and Rh type, animal versus human blood, identification of species, Gm factor, sex chromatin, karyotyping.

f. Postmortem examination - occupational marks, evidence of pre-existing diseases, congenital defects, tattoos, evidence of prior injuries, operative scars and absence of organs due to prior surgical procedures provide the basis for comparison with medical and employment records.

g. Radiographic - films obtained during life are compared with postmortem films. Foreign materials and metallic fragments, not observed during the postmortem examination, may be detected. Comparison of dental radiographs. Radiographic evaluation of ossification and fusion of epiphyses, as well as of dental development, may provide estimate of age in children and young adults.

3. Association with or exclusion of remains from other unknown remains based upon individual characteristics, sex, or other factors.

## IV. Special Procedures

### A. General

1. For each unknown remains, as well as for multiple remains, prepare diagrams and tables for comparison between the unknown and the known features.
2. Examine eyeglasses, including frames and lenses, for comparison with medical records.
3. Look beneath eyelids for contact lenses. Examine lenses with ultraviolet light for markings of manufacturer.
4. If there is a glove-like separation of the epidermis from the hands, the "glove" may be used to obtain fingerprints. If the epidermis is missing, it may be possible to fingerprint the denuded hands. If the hands are putrefied, dessicated, or charred, submit them to Identification Division, FBI, for further study.
5. Examine clothing and describe the size, color, condition and type of each garment. Record descriptions of laundry marks, labels, and name tags. Examine for invisible laundry marks with ultraviolet light.
6. Remove and examine dentures for name and identification number of individual which may be embedded in the denture base.
7. Examine personal effects such as rings, watches, belt buckles,

and bracelets for engraved markings. Determine if keys found on the remains provide access to the home or automobile of the missing person.

B. Teeth

1. Compare antemortem and postmortem dental x-rays and records.
2. Microscopic examination of ground sections of teeth to determine age.

C. Bones

1. When there is commingling of skeletal remains, examine bones with short wave ultraviolet light to segregate the bones.
2. Prior to examination of the bones, arrange in anatomic order.
3. Obtain photographs and x-rays of bone lesions for comparison with antemortem films.
4. Examine pubic bones for parturition pits, indicative of prior pregnancy.
5. Determine estimate of living stature from accurate measurement of long bones and comparison with tables in textbooks.
6. Record degree of ossification and fusion of epiphyses for comparison with tables of ossification centers in textbooks.
7. Examine anterior surface of pubic symphysis in Caucasian male adults for comparison with models for estimate of age.
8. Microscopic examination of ground sections of teeth and cross sections of shafts of long bones for estimate of age.

D. Hair and Fingernails

1. Obtain samples of known and unknown fingernails and hair for comparison by neutron activation analyses.

2. Comparison microscopic examination of linear striations of fingernails.

E. Toxicologic Studies

1. Retain tablets or capsules found in stomach for subsequent examination and identification.
2. Obtain studies, as appropriate, for alcohol, drugs, carbon monoxide and other toxic agents prior to embalming. Preserve samples by freezing.
3. In exhumed bodies, obtain samples of soil, water in grave, and fluids in casket for subsequent analysis.

F. Microscopic Examinations

1. Confirmation of gross pathologic findings.
2. Distinguish between antemortem and postmortem injuries.
3. Estimate of age of antemortem injuries by extent of inflammatory response or reparative processes.

G. Reconstruction

1. Comparison of photographs of ears with antemortem photographs.
2. Restoration of the head from the skull and comparison with antemortem photographs.

V. Pitfalls - Do's and Don'ts

A. Do

1. Establish perimeter and maintain security during the on-the-scene investigation.
2. Have consecutive numbers for bodies and related personal effects in mass disasters.

3. Establish and maintain chain of custody for physical evidence.

4. Obtain consultative assistance of physical anthropologists, dentists, radiologists and other specialists, as indicated.

5. Obtain photographs, x-rays and other special studies required for identification.

6. Obtain all available records for review and correlation with the investigative and pathologic findings.

7. Examine, describe, record, and tabulate results of examinations for comparison with known information.

B. Don't

1. Consider the burned, decomposed, mutilated, or skeletal remains as unsuitable for examination.

2. Fail to recognize artifacts and postmortem injuries.

3. Attempt to examine commingled skeletal remains. Segregate the bones and arrange in anatomic order.

4. Rely upon personal identification by relatives or friends.

5. Place specimens for toxicologic studies in formalin solution.

6. Confuse the remains of animals with human remains.

7. Fail to prepare a contingency plan for a disaster in your community.

## SELECTED REFERENCES


1. Bass, W. M.: Recent developments in the identification of human skeletal material. Am J Phys Anthrop 30:459-462, 1969.
2. Garn, S. M., Rohmann, C. G., and Silverman, F. N.: Radiographic standards for postnatal ossification and tooth calcification. Med Radiogr Photogr 43:44-66, 1967.
3. Iannarelli, A. V.: The Iannarelli System of Ear Identification. Police Science Series, The Foundation Press, Inc., Brooklyn, New York, 1964.
4. Identification of Deceased Personnel, Department of the Army Technical Manual 10-286. Headquarters, Department of the Army, Washington, D. C., January 1964.
5. Kerley, E. R.: Age determination of bone fragments. J Forensic Sci 14:59-67, 1969.
6. Krogman, W. M.: The Human Skeleton in Forensic Medicine. Charles C. Thomas, Springfield, Illinois, 1962.
7. McKern, T. and Stewart, T. D.: Skeletal age changes in young American males. Technical Report EP-45, Headquarters, Quartermaster Research and Development Command, Natick, Massachusetts, May 1957.
8. Problems and Practices in Fingerprinting the Dead. Reprinted from the FBI Law Enforcement Bulletin, April 1949. (Revised January 1962).
9. Reals, W. J. (Editor): Medical Investigation of Aviation Accidents. College of American Pathologists, Chicago, 1968.
10. Spitz, W. U., Sopher, I. M., and DiMaio, V. J. M.: Medicolegal Investigation of a bomb explosion in an automobile. Chronological account of the explosion in Bel Air, Md., March 9, 1970. J Forensic Sci 15:537-552, 1970.

11. Stewart, T. D.: Evaluation of Evidence from the Skeleton. In Legal Medicine edited by R. B. H. Gradwohl, The C. V. Mosby Co., St. Louis, 1954, pp. 425-427.

12. Stewart, T. D.: Identification by the Skeletal Structures. In Gradwohl's Legal Medicine edited by F. E. Camps, 2nd Edition, The Williams and Wilkins Company, Baltimore, 1968, pp. 123-154.

13. Stewart, T. D. (Editor): Personal identification in mass disasters. National Museum of Natural History, Smithsonian Institution, Washington D. C., 1970.

14. Suzuki, K. and Tsuchihashi, Y.: Personal identification by means of lip prints. J Forensic Med 17:52-57, 1970.

15. Thomas, F. and Baert, H.: The longitudinal striation of the human nails as a means of identification. J Forensic Med 14:113-117, 1967.

16. Trotter, M. and Gleser, G. C.: Estimation of stature from long bones of American Whites and Negroes. Am J Phys Anthrop 10:463-514, 1952.

17. Wecht, C. H.: The Medico-Legal Autopsy Laws of the Fifty States, The District of Columbia, American Samoa, The Canal Zone, Guam, Puerto Rico, and the Virgin Islands. American Registry of Pathology, Armed Forces Institute of Pathology, Washington, D. C., 1971.

*Wayne D. Lord,[1] Ph.D. and John F. Burger,[2] Ph.D.*

# Collection and Preservation of Forensically Important Entomological Materials

**REFERENCE:** Lord, W. D. and Burger, J. F., "Collection and Preservation of Forensically Important Entomological Materials," *Journal of Forensic Sciences*, JFSCA, Vol. 28, No. 4, Oct. 1983, pp. 936–944.

**ABSTRACT:** The insects and other invertebrates colonizing corpses as decomposition progresses can provide valuable information concerning the time and manner of death. Accurate determinations are possible, however, only when representative specimens are properly collected and preserved. The protocol developed by the authors describes equipment and techniques for sampling, preserving, packaging, shipping, and rearing forensically important insects. This information should aid medicolegal professionals in data collection, allowing accurate determinations by entomological means.

**KEYWORDS:** pathology and biology, entomology, sampling, preservation, rearing, Insecta, time of death, Diptera, Coleoptera

Forensic entomology is based on the analysis of insects and other invertebrates sequentially colonizing a corpse as decomposition progresses, and on the developmental stages of their offspring. The use of entomological information in determining manner of death, movement of a cadaver from one site to another, and length of the postmortem interval is well documented [*1–12*]. A comprehensive review of the subject and bibliographies are presented by Nuorteva [*11*] and Smith [*12*], respectively.

Although accurate forensic science determinations depend upon the proper collection, preservation, and rearing of entomological specimens, detailed descriptions of these techniques are not available in the forensic science literature. Brief descriptions of sampling and rearing procedures are presented by Easton and Smith [*9*] and Nuorteva et al [*4*].

The following paper is a protocol for the collection, preservation, and rearing of forensically important entomological materials. Attention is given to the recognition of major carrion-frequenting insect groups, representative sampling, methods of preserving adults and immature stages, rearing techniques, packaging and shipping, and important supplemental data. This information should aid medicolegal professionals in data collection, allowing more accurate forensic science determinations by entomological means.

## Collection Procedures

While many insects may provide information of forensic science importance, two groups, Diptera (true flies) and Coleoptera (beetles) are most important during the first two months of

Scientific Contribution No. 1195 from the New Hampshire Agricultural Experiment Station. Received for publication 28 Oct. 1982; revised manuscript received 4 Feb. 1983; accepted for publication 7 Feb. 1983.

[1]Graduate research assistant, Department of Zoology, University of New Hampshire, Durham, NH and Shoals Marine Laboratory, Appledore Island, Isles of Shoals, ME.

[2]Associate professor, Department of Entomology, University of New Hampshire, Durham, NH.

decomposition. One must recognize adult and immature stages of locally abundant carrion-frequenting insects to make meaningful specimen collections. The major families of forensically important insects are given in Table 1. Several authors have described the biology identification of these and other groups [*12-19*].

Collect representative insects (both adults and immature) on, in, and beneath the corpse. Adult forms may be killed and preserved immediately. Divide representative samples of immature stages into two subsamples. Preserve one immediately, and retain the other alive for later rearing to adult stages. Collect sufficient numbers of individuals to ensure complete representation of the insect populations present. When available, collect a minimum of 100 immatures for rearing. Basic materials necessary for collection of entomological specimens are given in Table 2. These materials can be carried in a small box or kit and stored with other specialized equipment until needed.

### *Flying Insects*

Flying insects can be collected with a standard insect or a short-handled hand net. It is important to make collections *as soon as possible*. Once collected, specimens can be retained indefinitely for analysis. Preserve all forensically important adult insects in 70% ethanol, or isopropyl alcohol diluted 1:1 with water. Higher concentrations of isopropyl alcohol may cause specimens to become brittle. Do not use formalin to preserve insects, unless no other preserving fluid is available. Transfer formalin preserved material to alcohol as soon as possible. A small hand net and preserving fluid can easily be carried as part of standard equipment.

### *Crawling Insects*

Collect crawling insects from the surface of, and within the corpse using forceps or with fingers. During sampling, hands should be protected with surgical gloves at all times. Collect smaller specimens (under 5 mm) with a small artist's paint brush dipped in the preserving fluid.

Collect crawling insects on the ground beneath the corpse by scooping the top few centimetres of soil into a plastic bag. Chill the bag of soil, if possible, until the insects are extracted and preserved to prevent further growth or possible predation and asphyxiation. This is particularly important when wandering fly larvae are preparing to pupate and are subject to predation by beetles and other soil-inhabiting insects.

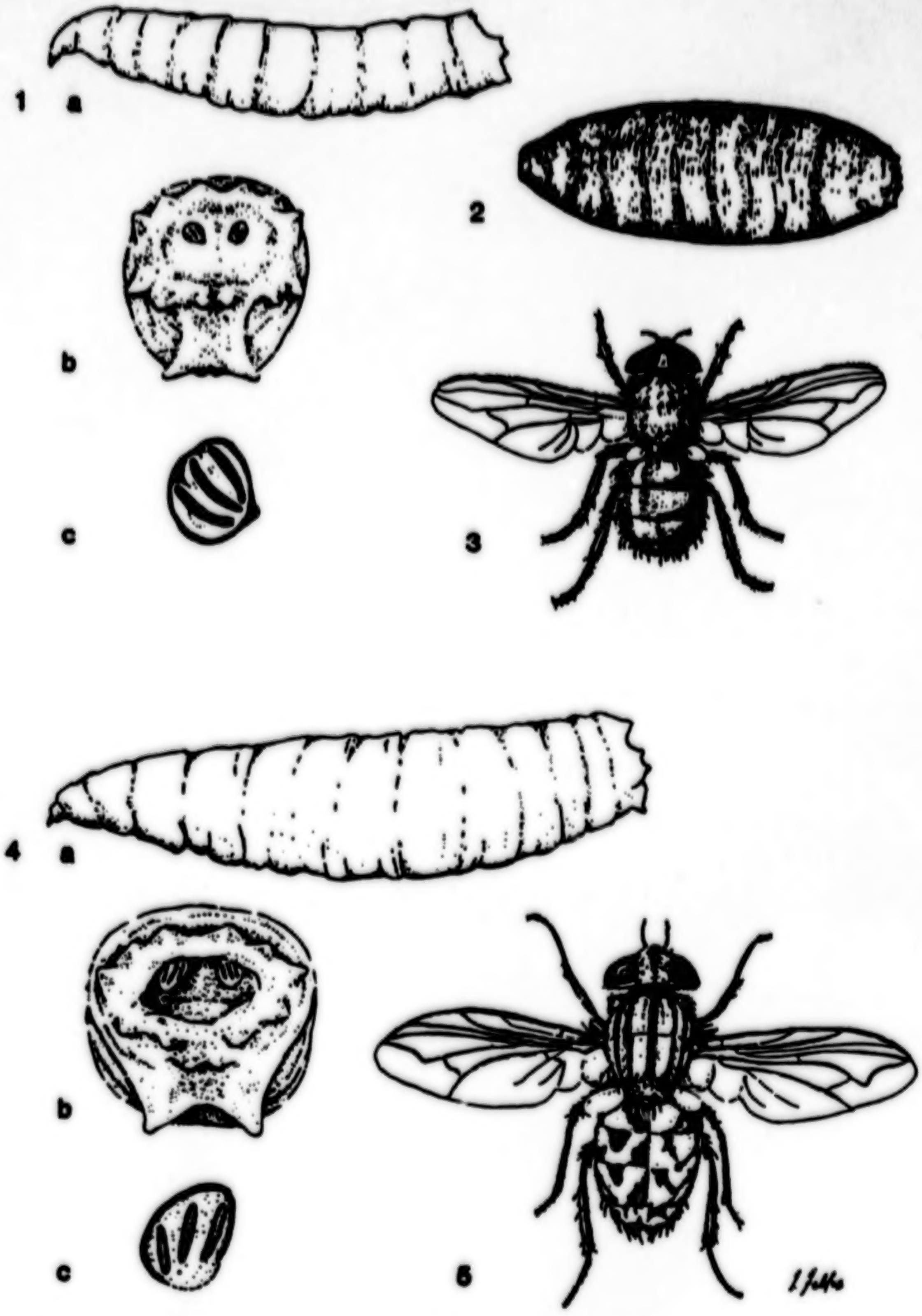
TABLE 1—*Families of forensically important insects.*

DIPTERA (TRUE FLIES)

1. Muscidae (muscid flies)
2. Calliphoridae (blow flies) (Figs. 1*a*-*c*, 2, and 3)
3. Sarcophagidae (flesh flies) (Figs. 4*a*-c and 5)
4. Sepsidae (scavenger flies) (Fig. 6)
5. Piophilidae (skipper flies) (Fig. 7)
6. Phoridae (scuttle flies or coffin flies) (Fig. 8)
7. Sphaeroceridae (small dung flies)

COLEOPTERA (BEETLES)

1. Dermestidae (skin beetles) (Figs. 9 and 10)
2. Silphidae (carrion beetles) (Fig. 11)
3. Histeridae (hister beetles) (Fig. 12)
4. Trogidae (trogid beetles) (Fig. 13)
5. Staphylinidae (rove beetles) (Fig. 14)
6. Nitidulidae (sap beetles)



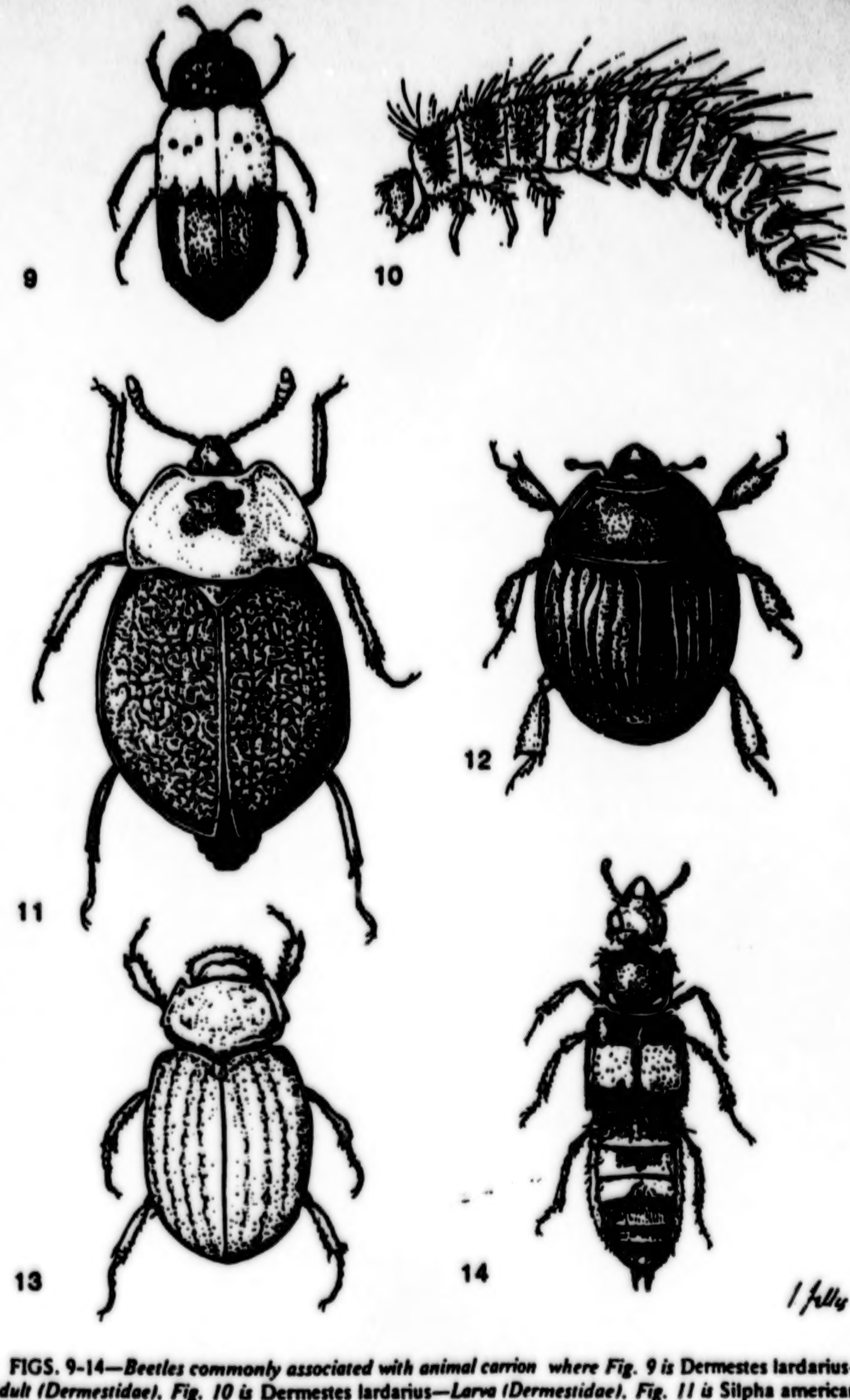

FIGS. 1-5—*Adult and immature stages of Calliphoridae* (1-3) *and Sarcophagidae* (4-5) *where 1*a *is larva of* Calliphora coloradensis; *1*b *is posterior view of* C. coloradensis *larva; and 1*c *is posterior spiracle of* C. coloradensis *larva (third instar). Fig. 2 is puparium of* Eucalliphora lilaea. *Fig. 3 is adult of* Phormia regina. *Fig. 4*a *is larva of* Blaesoxipha plinthopyga; *4*b *is posterior view of* B. plinthopyga *larva; and 4*c *is posterior spiracle of* B. plinthopyga. *Fig. 5 is adult of* Sarcophaga bullata.


FIGS. 6–8—*Adults of Sepsidae, Piophilidae, and Phoridae where Fig. 6 is* Sepsis vicaria, *Fig. 7 is* Piophila casei *and Fig. 8 is* Borophaga fuscipalpis.

*Burrowing Insects*

Some insects (that is, some beetles and mature fly larvae) burrow into the soil beneath the corpse. When the postmortem period is greater than three weeks, remove several samples of soil (0.25 $m^3$ each) from the area beneath the corpse. Place such samples carefully in plastic bags and analyze for beetles, mature fly larvae, and other soil arthropods.

To ensure complete sampling, it may be desirable for a person familiar with entomological




· FIGS. 9-14—*Beetles commonly associated with animal carrion where Fig. 9 is* Dermestes lardarius—*adult (Dermestidae). Fig. 10 is* Dermestes lardarius—*Larva (Dermestidae). Fig. 11 is* Silpha americana *(Silphidae). Fig. 12 is* Margarinotus cadaverinus *(Histeridae). Fig. 13 is* Trox suberosus *(Trogidae), and Fig. 14 is* Creophilus maxillosus *(Staphylinidae).*

TABLE 2—*Materials for collection of forensically important insects.*

| |
|---|
| Forceps |
| Glass vials |
| Ethyl alcohol (70%) or isopropyl alcohol (cut 1 : 1 with water) |
| Ice cream cartons or equivalent |
| Vermiculite or other inert material |
| Insect net (standard or hand net) |
| KAA[a] or similar larval perservative |
| Surgical gloves |
| Small artist brush |
| Plastic bags |
| Trowel |

[a]KAA: kerosene (refined), 1 part glacial acetic acid, 1 part 95% ethyl alcohol, 30 parts immerse larvae 10 min; rinse in 70% ethyl alcohol; and store in 95% ethyl alcohol.

techniques to collect soil samples subsequent to removal of remains. Be certain that the position of the corpse is clearly indicated, so that complete samples can be taken, since fly larvae may wander some distance from the corpse to pupate.

### *Immature and Soft-Bodied Insects*

Collect immature and soft-bodied insects by the methods described for crawling and burrowing insects. Special care is needed, however, to ensure proper preservation and rearing.

Place specimens to be immediately killed/preserved in vials of KAA solution (Table 2) for 10 min, then transfer to vials of 70% ethanol or isopropyl alcohol cut 1 : 1 with water. If larval fixing fluid is not available, place larvae in hot water (76.7°C [170°F]) for 2 to 3 min and then transfer to 70% ethanol. Various alternative larval preservatives can be used, depending on availability of chemicals [*20*].

Rearing specimens of immature flies or beetles to the adult stage requires proper food and laboratory conditions, but is essential for confirming identification of species and ensuring accurate estimates of postmortem duration. Rearing is most easily conducted by entomologists with appropriate materials and facilities.

Place living specimens in a 0.24-, 0.47-, and 0.95-L (½-pt, 1-pt, or 1-qt) ice cream carton or similar container ¼ to ½ filled with a coarse, inert material such as vermiculite. Moist soil can be used, if other materials are not available. Do *not* put living specimens to be reared in sealed plastic bags or sealed vials for longer than 12 h, since they do poorly in such environments, especially in warm weather. Transport living material by the fastest possible means to the rearing facility. Use of regular mail service usually is not suitable for transporting living material.

Immature flies can be successfully reared on diets of beef liver, or on small pieces of musculature obtained from the corpse. Transfer larvae gently via forceps onto the dietary material, which has been previously placed atop a 4 to 8-cm deep container filled with damp, coarse soil or vermiculite. Small glass dishes 8 to 10 cm in diameter, or beakers (250 mL), are suitable. Small cultures each containing 15 to 25 larvae afford maximum rearing success. Place these larval cultures inside standard insect rearing cages until adult flies emerge. Check larvae daily and record larval size and instar. Add additional liver as needed. Take care to allow only minimal culture disturbance. Mature larvae will migrate downward into the substrate and pupate. Adult flies will eventually emerge, crawl to the surface, and fly in the cages.

Whenever possible, rear larvae in climatic conditions approximating those to which the corpse was exposed. Environmental chambers are useful, if available. Temperature is the most critical factor. Calculations of the average time interval required for each developmental stage (larval instars, prepupae, pupae, and adult emergence) allow accurate determination of corpse colonization, approximating the time of death.

Allow emerged adults to feed for 24 h on a cotton pad soaked with a 10% sucrose solution. This ensures exoskeletal hardening. Species identifications can then be made. Preserve adult flies in 70% ethyl alcohol or pin them dry [19] and store in insect boxes.

Immature beetles need not be reared and should be preserved in 70% ethyl alcohol for identification.

### *Other Biological Materials*

Other observations on the kinds of animals and plants found in, on, and around the corpse may provide supplementary information about the time, cause, and location of death. Collect samples of any "unusual" specimens (that is, leaves from branches of trees used to cover a corpse, plants beneath the corpse, fleas, body lice, seaweeds, and so forth). Likewise, collect representative samples of specimens encountered at autopsy for analysis. Process any insect specimens observed during autopsy as described above and carefully record sites where found. Aquatic plants and marine specimens are best preserved in 10% neutral buffered formalin.

### *Labeling*

Label containers, vials, and packages of specimens individually with the following information:

(1) date collected;
(2) time collected;
(3) location of remains (as precise as possible);
(4) area of body infested; and
(5) name, address, and telephone number of collector(s).

### *Shipment of Specimens*

Package containers and vials of preserved specimens in well-cushioned containers to avoid breakage, and ship by the most convenient means. If shipped by regular post, wrap each vial individually in cellucotton and place in a box with *at least* 50.8 mm (2 in.) of styrofoam chips surrounding all sides, top, and bottom. This will minimize possibility of breakage. Clearly mark LIQUID IN GLASS on the container. This usually will receive gentler handling by the post office.

Package soil samples and other living specimens in containers that maintain relatively cool, humid, well-ventilated environments. Time is critical if accurate information is to be obtained from living material. Ship such material by the most rapid means available.

As with other types of physical evidence, take care to ensure a continuous chain of legally acceptable evidence possession.

## Description of Locality

An accurate, detailed description of the habitat in which a corpse was found is important to forensic biologists. Whenever possible, written descriptions should be accompanied by a series of photographs. Descriptions and photographs should illustrate the following:

(1) general habitat type—woods, pasture, field, beach, swamp, roadside, parking lot, dump, and so forth;

(2) terrain—hillside (north- or south-facing slope), valley, plateau, and so on including elevation if possible, and location on topographic maps;

(3) vegetation—trees, shrubs, grasses, tall or short grass, and so forth; and

(4) type of soil—sandy, rocky, clay, mud, gravel, asphalt, and so forth.

### Description of the Corpse

A detailed photographic and written description of the corpse is necessary, including the following:

(1) sex, age, height, weight;
(2) presence and extent of clothing;
(3) orientation (sitting, prone, and so on);
(4) cause of death;
(5) physical damage (lacerations, abrasions, gunshot wounds, and so forth);
(6) extent of decomposition; and
(7) insect fauna (close-up photographs of adult and immature insects whenever possible).

### Microclimate

Because microclimatic conditions have a profound effect on the development of immature insects, the most accurate data available describing these conditions at the location where the corpse is found are of critical importance. Whenever possible, record maximum and minimum temperature values at the scene as soon as possible after discovery. Obtain climatic data from the nearest National Oceanic and Atmospheric Administration (NOAA) weather station for the entire estimated postmortem period and for a two-week interval before estimated time of death. Photographs depicting relative amounts of sunlight and shading of the corpse during the day are useful if available.

### Summary

Insects associated with carrion display successional stages closely related to time of death, with each group arriving at specific times following deaths. These intervals can be prec correlated for each geographic area and used to aid investigations into time and mann death. It must be recognized, however, that many factors can alter the normal time sequence of carrion insect succession. The most important of these are:

(1) time of day or night that death occurred;
(2) location of corpse following death;
(3) exposure of corpse, including burial, clothing, covering by vegetation, and so on;
(4) presence of external wounds and their position;
(5) temperature;
(6) sunlight and other weather conditions;
(7) length of time corpse in sun or shade;
(8) time of year;
(9) change of location following death;
(10) immersion in water (fresh or salt); and
(11) freezing and thawing.

Any of the above factors will alter the normal course of succession in carrion insects. However, this alteration can often be used to determine if the corpse has been disturbed outdoors following death, if buried and later exhumed, and other details of possible evidentiary importance.

Forensically important insects can be a powerful tool in investigations of homicide and other deaths, particularly if care is taken to collect specimens and record information. The preceding protocol should allow professionals to collect enough data to ensure the most accurate forensic science determinations possible by entomological means.

### *Acknowledgment*

We wish to thank Tess Feltes for the illustrations of insect adults and larvae associated with animal carrion.

## References


[1] Megnin, P., "La Faune des Cadavres, Application l'Entomologie a la Medicine Legale," *Encyclopédie Science Aide-Mémoire*, Paris, 1894.

[2] Motter, M. G., "A Contribution to the Study of the Fauna of the Grave. A Study of One Hundred and Fifty Disinterments, with Some Additional Experimental Observations," *Journal of the New York Entomological Society*, Vol. 6, No. 4, Dec. 1898, pp. 201-231.

[3] Payne, J. A., "A Summer Carrion Study of the Pig *Sus scrofa*," *Ecology*, Vol. 46, No. 5, 1965, pp. 592-602.

[4] Nuorteva, P., Isokoski, M., and Laiho, K., "Studies on the Possibilities of Using Blowflies as Medico-legal Indicators in Finland. I. Report of Four Indoor Cases From the City of Helsinki," *Annales Entomologici Fennici*, Vol. 33, 1967, pp. 217-225.

[5] Nuorteva, P., "Age Determination of a Blood Stain in a Decaying Shirt by Entomological Means," *Forensic Science*, Vol. 3, 1974, pp. 89-94.

[6] Leclerq, M., *Entomological Parasitology—The Relations Between Entomology and the Medical Sciences*, Pergamon Press, London, 1969.

[7] Leclerq, M. and Watrin, P., "Entomologie et medecine legale. Acariens et insectes trouves sur un cadavre humain en decembre 1971," *Bulletin et Annales de la Societe Royale D'Entomologie de Belgique*, Vol. 109, 1971, pp. 195-201.

[8] Leclerq, M., "Entomologie et medecine legale. Etude des insectes et acariens necrophages pour determiner la date de la mort," *Spectrum*, Vol. 17, Nov.-Dec. 1975, pp. 1-6.

[9] Easton, A. M. and Smith, K. G. V., "The Entomology of the Cadaver," *Medicine, Science and the Law*, Vol. 1, 1970, pp. 208-215.

[10] Lane, R. P., "An Investigation into Blowfly Succession on Corpses," *Journal of Natural History*, Vol. 9, No. 5, Sept.-Oct. 1975, pp. 581-588.

[11] Nuorteva, P., "Sarcosaprophagous Insects as Forensic Indicators," in *Forensic Medicine: A Study in Trauma and Environmental Hazards*, C. G. Tedeschi, W. G. Eckert, and L. G. Tedeschi, Eds., W. B. Saunders Co., Philadelphia, 1977.

[12] Smith, K. G. V., *Insects and Other Arthropods of Medical Importance*, British Museum (Natural History), London, 1973.

[13] Aldrich, J. M., *Flies of the Genus Sarcophaga in North America*, Thomas Say Foundation, Lafayette, IN, 1918.

[14] James, M. T., *The Flies That Cause Myiasis In Man*, Miscellaneous Publication 631, U.S. Department of Agriculture, 1947.

[15] Hall, D. G., *The Blowflies of North America*, Thomas Say Foundation, Baltimore, 1948.

[16] Oldroyd, H., *The Natural History of Flies*, William Cloves & Sons, Inc., London, 1964.

[17] Dillon, E. S. and Dillon, L. S., *A Manual of Common Beetles of Eastern North America*, Vols. I & II, Dover Publications, Inc., NY, 1972.

[18] Borror, D. J., Delong, M., and Triplehorn, C. A., *An Introduction to the Study of Insects*, 5th ed., Saunders Publishing Co., Philadelphia, 1981.

[19] McAlpine, J. F., Ed., *Manual of Nearctic Diptera*, Vol. I, Agriculture Canada Monograph 27, Research Branch, Ottawa, 1981.

[20] Peterson, A., *Larvae of Insects*, Edwards Brothers, Inc., Ann Arbor, MI, 1962.

# Death Scene Checklist

By JAMES C. BEYER, M.D.
*Deputy Chief Medical Examiner*
*Office of Chief Medical Examiner*
*Northern Virginia Division*
*Falls Church, Va.*
and
WILLIAM F. ENOS, M.D.
*Pathologist*
*Northern Virginia Doctors Hospital*
*Arlington, Va.*

Within the United States there are still considerable variations in the medicolegal structure used in death investigations. This ranges from the county coroner system to the statewide medical examiner system, with intervening admixtures of both.[1] With the continuous turnover of personnel assigned to homicide squads and criminal investigation divisions, there is an ever-present need for reinforcing the close cooperation which must exist between medical examiners, forensic pathologists, and law enforcement personnel. If a close working relationship does not prevail, neither group can fulfill adequately their obligation. Every death investigation requires employing all available medical and investigative talents and facilities. However, since there are well-established medical examiners' offices or their equivalents in most large cities, many of the problems inherent in smaller jurisdictions or in rural areas are not present.

It is a recommended practice that trained medical personnel be present at all death scene investigations to assist officers in the initial investigation and help formulate preliminary concepts as to possible cause and manner of death. In jurisdictions where a medical examiner system is in operation, responsible medical personnel are available to respond to the officer's request for assistance. In addition, most medical examiners' offices have investigators as staff members who will also be called to the death scene and who will act as liaison between the medical examiner's office and the local law enforcement office. In this way, they can collect the necessary information for the forensic pathologist performing the post mortem examination.

In a hospital environment, the staff pathologist who performs post mortem examinations will not initiate such a procedure before reviewing the deceased's hospital record and possibly discussing the case with the attending physician. This review is not intended to develop any preconceived ideas as to probable cause of death but to assist the pathologist in examining, collecting, and preserving the essential tissues required to develop a diagnosis as to cause of death. If this procedure is followed in the relatively controlled environment of a hospital, it is even more important for the pathologist performing a medicolegal autopsy to be aware of all the circumstances surrounding the death, as well as the past medical and surgical history of the deceased. Additional information on past occupations, sexual habits, drug usage and abuse, and alcohol habits may also be required.

( Published by the Federal Bureau of Investigation, U.S. Department of Justice. )
Reprinted from the FBI Law Enforcement Bulletin, August, 1981.

A member of the investigative team should be present during all or part of the post mortem examination of every homicide, suspicious death, suicide, and most accidents. Both the pathologist and investigating officer should agree to a suitable time to conduct the post mortem examination so no one is inconvenienced. The police officer can furnish the pathologist with a complete description of the death scene, along with available photographs. Also, investigators of the medical examiner's office who were at the scene should also be present to contribute to the discussion and supply their own photographs. At this time, the police officer can indicate those materials he wants collected as possible evidence and any specialized examinations which he believes are essential to the investigation. During the autopsy, the officer can gain complete firsthand information regarding the cause and suspected manner of death, as well as having direct transfer of all available evidence material. While the latter is not important in the larger medical examiner's office, it is crucial to maintain the chain of custody when autopsies are performed in hospitals and funeral homes. The police officer also contributes to the interpretation of the autopsy findings by describing the anatomic position of the deceased at the scene and any evidence of movement by the deceased following the initial injury. The police officer will also be able to describe and furnish for examination any potential weapons. Upon completion of the autopsy, in most instances, the police officer will know the probable cause of death, the device used to inflict injury, and any additional information which would indicate the need to search the death scene further. He may also be furnished with information indicating the possible habits or personality of the potential assailant, which is most characteristic in the overkill type of injury seen in deaths of homosexual individuals. Therefore, it is evident that the performance of the autopsy and the subsequent interpretation of the findings are greatly enhanced by the presence of the police officer.

**". . . a Death Scene Checklist . . . not only would be of value to the pathologist but would also serve as a readily available source of essential information."**

In cases where a medical examiner or his investigator were not at the scene or where a police officer cannot be present at the autopsy, it is still essential that certain information be furnished to the pathologist before the autopsy is performed. In order to accomplish this, it might be necessary for a Death Scene Checklist to be completed at the scene and forwarded to the pathologist with the deceased's body. This list not only would be of value to the pathologist but would also serve as a readily available source of essential information. Many jurisdictions already have such lists compiled, and in no way should the proposed checklist be construed as a definitive or all-comprehensive form. Whatever list is used, it should require a minimum amount of writing, and in many cases, questions should be answered simply by checking or circling the appropriate word or phrase.

The checklist is intended to serve only as a guide and can be modified by the jurisdictions adopting it to serve their individual needs. Such a list would have its primary impact in those jurisdictions where the pathologist performing a forensic autopsy has had little, if any, contact with the investigating officers, which results in a scarcity of information regarding the circumstances surrounding the death. It has been our experience in a number of cases that such information, if provided, would have greatly facilitated our post mortem examinations and relieved our unfounded apprehensions.

**Case No. 1** The body of an adult white male with a gunshot wound to the head was sent in for post mortem examination. The information from the local medical examiner led us to believe this was a suicide case. However, further examination revealed a contact-type gunshot wound near the back and top of the head. Even though it would be physically possible for an individual to shoot himself in this area, it was considered to be a rather unusual anatomic location. Because of this finding, we became suspicious that this could be a homicide and believed local law enforcement officers should make a complete scene investigation. We soon learned from the officers that the individual was found in a locked room in a house belonging to a family member. A gun was also found with the deceased, who had recently evidenced depression and suicidal tendencies. After receiving this information, we also could agree that the manner of death was suicide.

**Case No. 2** We received the body of an adult white female who had sustained multiple shotgun wounds. Examination of the body revealed two perforating shotgun wounds in the left lateral chest wall with no evidence of any penetration into underlying organs, a perforating shotgun wound of the right lateral neck with no involvement of any major vascular structures, and a perforating shotgun wound of the left lateral neck with involvement of major vascular structures, spine, and spinal cord. Certainly, a pathologist viewing this would be highly suspicious that this was a homicide. However, subsequent information garnered through telephone calls with members of the investigating team revealed undisputed evidence that this also was a case of suicide.

**Case No. 3** Recently, we received the bodies of an adult black male and adult black female with the possible diagnosis of homicide and suicide. These conclusions were based upon evidence found at the scene. In this case, the investigating officers accompanied the bodies to the morgue and were present during the examinations. Ballistic findings unearthed by the autopsies proved this to be a double homicide. With the availability of this firsthand information, investigating officers could return to their jurisdiction and initiate a more intensive search for the assailant(s).

The importance of compatible, cooperative association between medical examiners, forensic pathologists, and law enforcement officers cannot be overemphasized. The performance of the medicolegal autopsy by the forensic pathologist cannot stand alone without supporting information generated by the law enforcement officer. Likewise, input from the forensic pathologist can assist and sustain the law enforcement officer throughout his investigation. The end result of such a cooperative venture will have a significant impact on society in the apprehension of the guilty and the protection of the innocent. FBI

**Footnote**

A full description of the systems by States is presented in the U.S. Department of Health, Education and Welfare Publication No. (HSA) 78-5252, DEATH INVESTIGATION.

# DEATH SCENE CHECKLIST

(This form is to be utilized as a supplementary source sheet for readily available information and is not intended to replace conventional reports. Copies should be distributed to investigating officers and medical examiners.)

Name of deceased:

First Middle Last

Address:

Age: Race: White Black Hispanic Asian American Indian Unknown

Sex: Male Female

Telephone number:

Marital status: S M W D Separated Unknown

Next-of-kin:

Name:

Address:

Telephone number:

Police Notified by:

Date: Time:

Name:

Address:

Telephone number:

Relationship to deceased:

**Deceased found:**

Date: Time:

Address: (if different from above)

Location: Apartment House Townhouse Other (describe)

Entrance by: Key Cutting chain Forcing door Other (describe)

Type of lock on door:

Condition of other doors and windows: Open Closed Locked Unlocked

**Body found:**
Living Room Dining Room Bedroom Kitchen Attic Basement Other (describe)

Location in room:

Position of body: On back Face down Other:

**Condition of body:**

Fully clothed Partially clothed Unclothed

Preservation: Well preserved Decomposed

Estimated Rigor: Complete Head Arms Legs

Livor: Front Back Localized

Color:

Blood: Absent Present Location

Ligatures: Yes No

**Apparent wounds:** None Gunshot Stab Blunt force

Number:

Location: Head Neck Chest Abdomen Extremities

Hanging: Yes No Means:

**Weapon(s) present:** Gun (estimate caliber )

Type:

Knife:

Other (describe)

[illegible] Untidy Disarray

[illegible] Other

---

[illegible]

Where:

Type:

---

Dated materials:

Mail:

Newspapers:

TV Guide:

Liquor Bottles:

---

Last contact with decedent:

Date:

Type of Contact:

Name of Contact:

---

Evidence of robbery: Yes No Not determined

---

Identification of decedent: Yes No

If yes, how accomplished:

If no, how is it to be accomplished:

---

Evidence of drug use: (prescription and nonprescription) Yes No

If drugs present, collect them and send with body.

---

Evidence of drug paraphernalia: Yes No

Type:

---

Evidence of sexual deviate practices: Yes No

Type: (collect and send with body)

Name and telephone number of investigating officer:

---

NOTES

NOTES

BLANK PAGE

* * * * *

# Injuries From Edged Weapons and Their Effect on the Body

* * * * *

BLANK PAGE

# AN OVERVIEW

# OF

# INJURIES FROM EDGED WEAPONS AND

# THEIR EFFECT ON THE BODY

Arthur E. Westveer
FBI Academy
Quantico, Virginia

BLANK PAGE

Injuries from edged weapons are:

chop, stab, incised

92% of police injuries are caused by edged weapons.

Most injuries to police officers from edged weapons occur on "disturbance" calls.

The most common weapon used to inflict these injuries is a screw driver.

The minimum reaction distance from an assailant welding an edged weapon is 21 feet.

<u>Stab Wounds</u>

Instrument: files, knives, scissors, etc. Usually flat and thin.

Sharp and slender: hat pins, needles, screw drivers.

Sharp and thick: axe, pitchforks.

Characteristic in:

Homicides
Suicides
Accidents

Cause of death:

Hemorrhage, massive, vital structure perforated/penetrated.
Example - arteries of the neck, heart, lungs and aorta.
Air embolism
Pneumothorax
Infection

Factors of medico legal importance

1. Instrument(s) used.
2. Direction of wound track
3. Depth of penetration
4. Width of knife
5. Number of wounds

Caution

1. Serrated knife - stab wounds not usually distinguishable from ordinary knife wounds.

2. The same knife may produce wounds with different appearances.

3. Confluent wounds may result from:

   a. Two separate thrusts
   b. Assailant twisted knife
   c. Victim twisted after knife entered the body

## NOTES

NOTES

* * * * *

# Blunt Force Injuries
# and
# Their Effects on the Body

* * * * *

BLANK PAGE

# AN OVERVIEW
# OF
# BLUNT FORCE INJURIES AND THEIR
# EFFECTS ON THE BODY

Arthur E. Westveer
FBI Academy
Quantico, Virginia

## Blunt Force Injuries

Definition

Wounds causes by blunt impact, as opposed to wounds caused by cutting and stabbing. Blunt force tears, shears and crushes.

Contusion - A bruise

May be patterned.
May be difficult to see in dark-skinned people.
More easily produced in some people then others - obese people, blondes, chronic alcoholics.

Color changes
1. Swelling initially
2. Light bluish-red few hours
3. Dark purple within one week
4. Greenish-yellow then brown

Color changes occur from the edge of the bruise to the center.

Laceration or Tear

Usually occurs where skin is taunt over bone (skull, knee, elbow, etc.)
Frequently surrounded by a contusion.

Lacerations will have an irregular shape, undermined edges, bridging or tissue, nerves and vessels.

Abrasions

Scraping injury - Superficial destruction of skin by friction.
May be patterned.
Caused by sliding across paved surface.
Traffic accident victims.
Linear abrasions (scratches) indicate direction of force.

Hematoma

A localized swelling caused by leakage of blood from damaged blood vessels.

Simple Fracture

A broken bone without fragmentation.

Comminuted Fracture

A broken bone with fragmentation.

Compound Fracture

A broken bone protruding through skin or just under broken skin.

Blunt injury to the head

Types of injuries

Concussion - A state of temporary unconsciousness - no hemorrhage or laceration. A disturbance of the electrical activity of the brain.

Epidural Hematoma - Hemorrhage between dura and skull, pressing on brain.

Subdural Hematoma - Beneath dura, pressing on brain.

Subarachnoid Hemorrhage - Bleeding beneath arachnoid. Slight subarachnoid hemorrhages are common in trauma.

Coup Contusion - Bruise of brain directly beneath site of impact to head.

Contre Coup Contusion - Bruise of brain distant from site of impact to head.

Cerebral Hemorrhage - Hemorrhage within the brain itself.

Blunt Injuries of Neck

Types of injuries

Fracture of Cervical Spine - Caused by impact on top of head or violent bending of neck forward or backward.
(Dive into shallow water, auto accident, fall)

Fracture of Larynx or Cricoid Cartilage

Direct blow to neck.

Fracture of Hyoid Bone - Manual strangulation.

Blunt Injuries of Chest and Abdomen]

Types of injuries

Aorta - Laceration - Upper chest - rapid death.

Heart - Puncture from rib or laceration with hemorrhage.

Lungs - Puncture from rib hemorrhage or escape of air into chest cavity.
Lung could collapse.

Liver and Spleen - Laceration of surface membrane. Bleeds internally. Death within a few hours.

Blunt Injuries of Extremities

Types of Injuries

Major blood vessels - lacerated by jagged ends of broken bones - Seldom causes death.

Fracture of Bones - Bumper fractures from autos.

Complications of blunt trauma.

Hemorrhage - From lacerations of blood vessels or organs; can be fatal.

Shock - Rapid or delayed aspiration of blood - Tracheobronchial tree.

Air Embolism - Air enters lacerated veins; can interfere with blood flow to lungs. Delayed.

Fat Embolism - Fat from marrow of fractured bones may enter veins - interferes with blood flow.

Infection of Wound

Phneumonia

Pulmonary Embolism - Blood clots may travel to lungs - Obstruct blood flow.

**FBI Academy**

**Closed Head Injuries**

Condensed from the Coup-condrecoup Mechanisms from the Iowa State Medical Examiner's Newsletter, January 1985.

Instructor: Arthur E. Westveer
FBI Academy
Behavioral Science
Instruction & Research Unit

BLANK PAGE

## Closed Head Injuries

The Coup-contrecoup Mechanisms coup-type injuries are those produced by focal compression of the skull (with or without fracture) with injury to the brain surface immediately beneath the area of impact. The smaller the contact area the greater the likelihood of a coup contusion. The effects are immediate, producing contusions ("Bruises") and hemorrhage. An impact from a flat surface usually causes no coup contusion.

A blow to the resting movable head produces coup-type injuries.

Contrecoup brain contusions occur opposite a point of cranial impact, independently of skull fractures. CONTRECOUP brain contusions are sustained when the moving or falling/accelerating head strikes a solid object. There is no proof that human coup-contre coup injuries are ever produced by any other mechanism than impact of the moving head against a solid object.

Principals concerning coup-contercoup head injuries are as follows:

1. A blow to the RESTING MOVABLE HEAD produces brain contusions beneath the point of impact (COUP-type injuries).

2. A MOVING HEAD strikes a firm or unyielding surface results in brain contusions opposite the point of impact (CONTRECOUP-type injuries).

3. A MOVING HEAD sustains mild or no COUP-type injuries (with rare exceptions) from an impact.

4. A RESTING HEAD sustains mild or no CONTRECOUP-type injuries (with rare exceptions from an impact.

5. The typical CONTRECOUP lesions have never been produced in man unless the head was in MOTION at the time of impact.

6. Occipital trauma (i.e., hitting the back of the head) for a moving head often results in frontal and temporal (contrecoup) brain injury (at least in part because the front base of the skull is rough).

7. Frontal trauma (hitting the front of the head) for a moving head rarely results in occipital (contrecoup) brain injury (at least in part because the back and back base of the skull is smooth).

8. A head fixed against a firm surface will sustain both coup and contrecoup type injuries when struck on the free surface (this is related to the elastic properties of the skull).

## Closed Head Injuries

The Coup-contrecoup Mechanisms coup-type injuries are those produced by focal compression of the skull (with or without fracture) with injury to the brain surface immediately beneath the area of impact. The smaller the contact area the greater the likelihood of a coup contusion. The effects are immediate, producing contusions ("Bruises") and hemorrhage. An impact from a flat surface usually causes no coup contusion.

A blow to the resting movable head produces coup-type injuries.

Contrecoup brain contusions occur opposite a point of cranial impact, independently of skull fractures. CONTRECOUP brain contusions are sustained when the moving or falling/accelerating head strikes a solid object. There is no proof that human coup-contre coup injuries are ever produced by any other mechanism than impact of the moving head against a solid object.

Principals concerning coup-contercoup head injuries are as follows:

1. A blow to the RESTING MOVABLE HEAD produces brain contusions beneath the point of impact (COUP-type injuries).

2. A MOVING HEAD strikes a firm or unyielding surface results in brain contusions opposite the point of impact (CONTRECOUP-type injuries).

3. A MOVING HEAD sustains mild or no COUP-type injuries (with rare exceptions) from an impact.

4. A RESTING HEAD sustains mild or no CONTRECOUP-type injuries (with rare exceptions from an impact.

5. The typical CONTRECOUP lesions have never been produced in man unless the head was in MOTION at the time of impact.

6. Occipital trauma (i.e., hitting the back of the head) for a moving head often results in frontal and temporal (contrecoup) brain injury (at least in part because the front base of the skull is rough).

7. Frontal trauma (hitting the front of the head) for a moving head rarely results in occipital (contrecoup) brain injury (at least in part because the back and back base of the skull is smooth).

8. A head fixed against a firm surface will sustain both coup and contrecoup type injuries when struck on the free surface (this is related to the elastic properties of the skull).

9. When trauma is sustained to the upper jaw or temple in a MOVING head, the major lesions are ALWAYS CONTRECOUP, coup lesions being lesser or even absent.

10. Contusions of the brain surface can result from the edges of fractured bones impacting the brain surface. In severe skull fractures, differentiating fracture-contusions from coup-contrecoup injuries may be difficult or even impossible.

BLANK PAGE

Figure 1

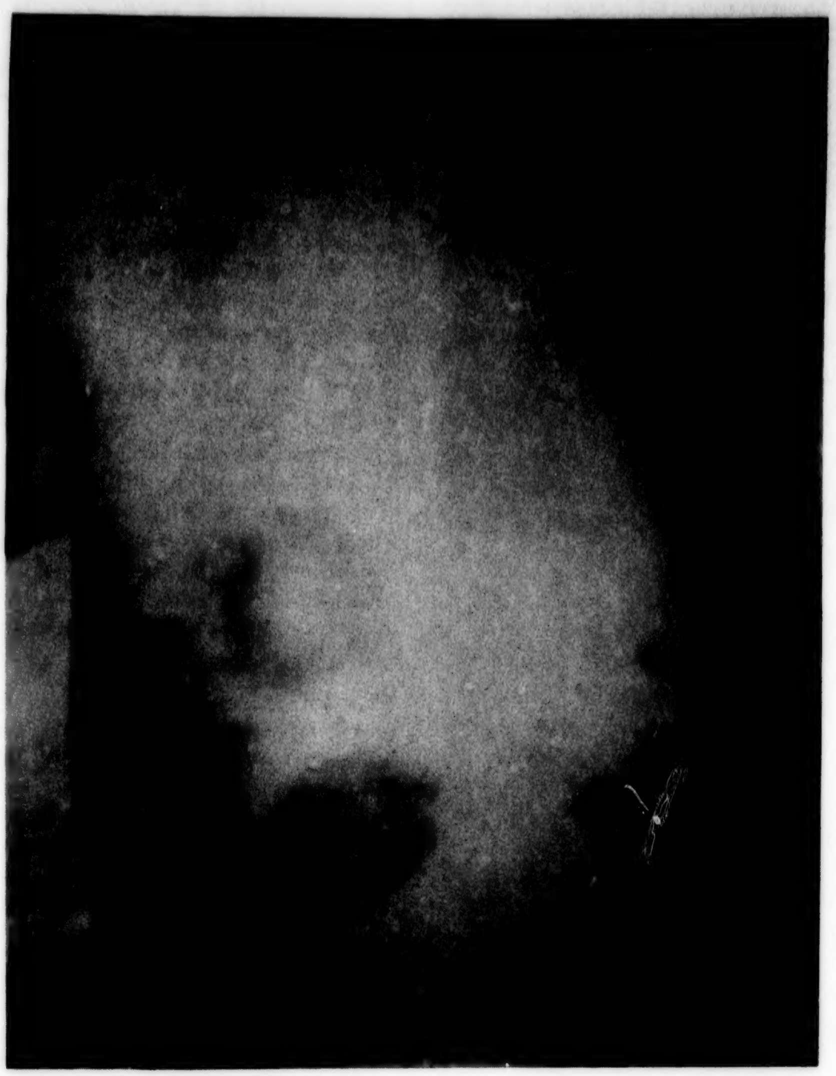


Figure 3

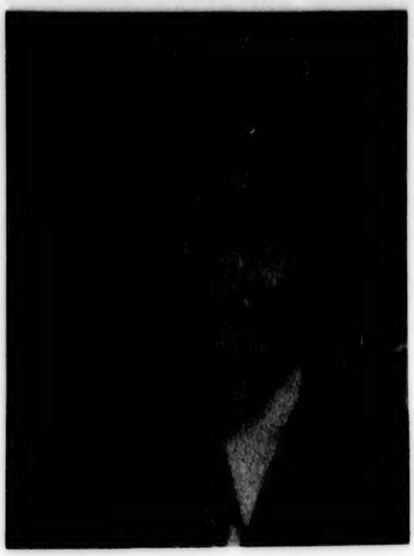
# Bite Mark Evidence in Crimes Against Persons

By NORMAN D. SPERBER, D.D.S.
*Forensic Odontologist*
*San Diego County Coroner's Office*
*San Diego, Calif.*

Figure 2



(PUBLISHED BY THE FEDERAL BUREAU OF INVESTIGATION, U.S. DEPARTMENT OF JUSTICE)
REPRINTED FROM THE FBI LAW ENFORCEMENT BULLETIN, JULY, 1981



*Dr. Sperber*

Bite mark evidence in felony cases (homicide, sex crimes, and child abuse) has been admitted in the superior courts of several States and in one U.S. military trial. If properly preserved and protected, bite marks can provide an important link between victim and assailant. It should be noted, however, that although assailants' bites on victims are the most common, equally incriminating would be those of the victim on the assailant.

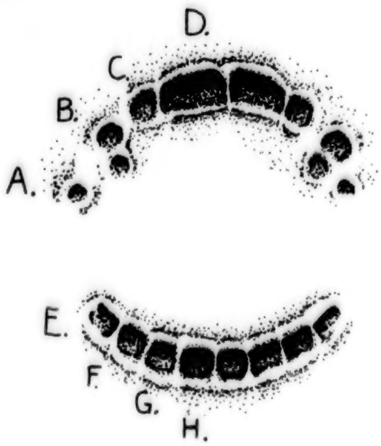
Although not always possible, it is ideal to have a forensic odontologist present at the outset of a case. However, since law enforcement officers are usually the first to interview a live victim or view the body of a dead one, it is important that they protect the bite site so that the forensic odontologist (specially trained dentist) may analyze the evidence and possibly testify at a later date.

**Recognition, Investigation, and Examination**

Investigators should be suspicious of any marks or bruises that appear to be bite marks on deceased or unconscious victims. The suspected bite site on a victim or assailant should not be washed until certain necessary steps have been taken. In addition, the suspected area should be examined without being touched.

A bite mark may reveal individual tooth marks as shown in figure 1, or as evident in figure 2, may appear as a double horseshoe. It may also resemble a doughnut or a solid marking. (See fig. 3.) Another possibility is the appearance of both upper and lower teeth marks, while on other victims, only the teeth of the jaw may be visible. In addition, the number of teeth marks may vary from several to only one.

*Figure 4*



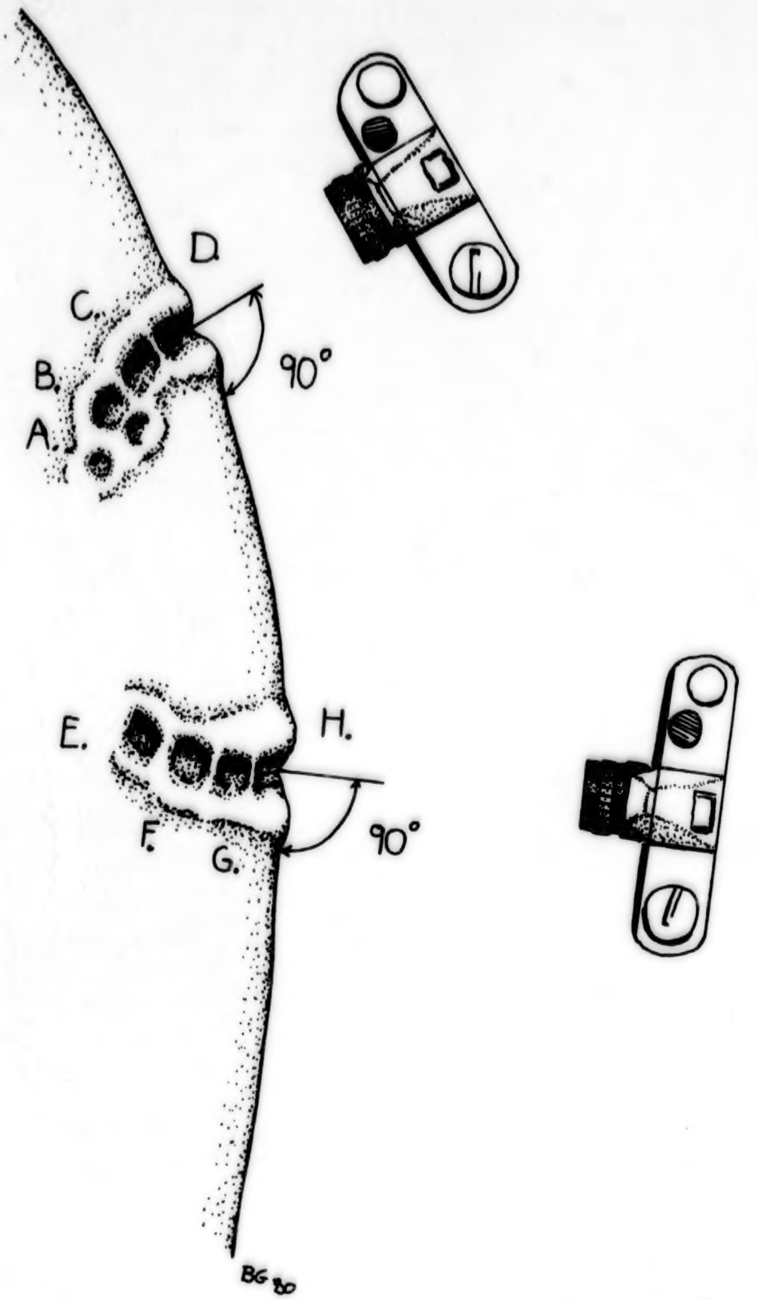

**Preliminary Photographs**

Photographs may be the most valuable type of evidence and should be taken immediately after the crime. Ideally, black and white *and* color film with appropriate lighting should be used. The camera (preferably a 35mm or other nondistorting model) is placed at right angles to the various curves of the bite. (See fig. 4.) Orienting photographs are taken before cleaning or wiping the area. A scale or ruler should be placed near the bite mark in some of the photographs.

**Swabbing Bite Mark Areas**

After taking the initial photographs, crime laboratory personnel, using a noncontaminating technique, should swab the site with distilled water or physiological saline solution. Using sterile gloves to avoid contamination, they should work from the periphery toward the center of the bite mark, allowing the swabs to dry for a few moments and then placing them in a sterile, sealed, marked test tube. The swabs should be promptly sent to a qualified laboratory for analysis. Swabbing of unbitten areas, for control purposes, is recommended. As an example, in the case of a left wrist bite, the right and left wrists should be swabbed and these swabs placed in separate, properly labeled test tubes. This technique is used to determine the major blood group (A,B,O,AB) of the assailant or victim "secretor." Eighty percent of the population are secretors who reveal their blood group in all body fluids (saliva, seminal fluid, tears, or perspiration). Therefore, if a suspect secretes a rare AB type of saliva and the victim has blood type O, the discrepancy can be incriminating, especially when the bite mark comparison reveals similar features. If there is question as to whether an injury is a bite mark, a qualified forensic laboratory technician can perform an evaluation for the presence of salivary amylase, prior to washing the area. Laboratory personnel should secure blood and salivary specimens from the victim. When a suspect is in custody, the same specimens should be obtained.[1]

*Figure 5*




## Final Photographs

After swabbing for saliva residue, the area is debrided, cleansed, and an orienting photograph taken. (An orienting photograph illustrates the relation of the bite mark to the body.) A ruler is placed as close to the bite mark as possible without obscuring it. (A flexible rule, e.g., tape measure, is unsatisfactory because distortion may be introduced on curved surfaces.) Then, a number of close photographs should be taken, also with the ruler in close proximity to the marks, with the camera lens placed perpendicular to the marks. (See fig. 5.) This procedure is especially important if bite marks are on rounded areas, e.g., shoulders, arms, legs, or breasts. Two or more rulers may be placed in a photograph to demonstrate that there is little or no distortion. Photographs should be repeated for 5 days at 24-hour intervals on live and dead victims, since bite marks may become more evident and distinct in the course of time. Victims should be refrigerated and should not be embalmed. (Embalming tends to "wash out" bite marks.) An autopsy should not be performed before photographing. Incisions or suturing in the proximity of bite marks are also to be avoided prior to taking photographs or bite mark impressions.

## Bite Mark Impressions

Bite mark impressions should be taken by a forensic odontologist, dentist, or experienced crime lab technician, using standard, accurate impression materials. If it is not possible to have experienced personnel take the impression, the following procedures are recommended:

1) Orient the bitten area horizontally, so that the impression material does not flow away from the bite. (See fig. 6.)
2) Place the impression material gently over the area and allow to set. Setting time is prolonged if the body is refrigerated. (See fig. 7.)
3) Allow orthopedic tape warmed in hot water to settle over the set impression material, providing rigidity without distortion. (See fig. 8.)

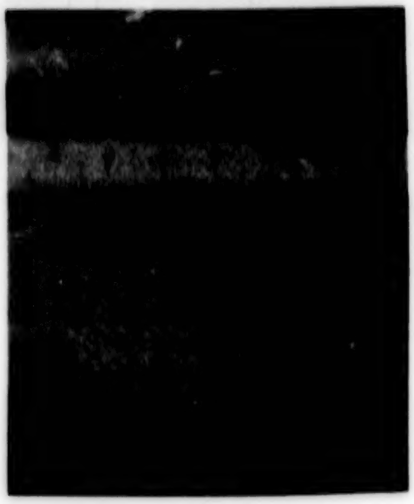


*Figure 6*

*Figure 7*

4) Place another mix of impression material over the tape to "lock" it securely into place. (See fig. 9.) This results in the "lifted" impression. (See fig. 10.) A model of the bite mark can then be fabricated.

### Impressions and Photographs of Suspect

If a suspect is in custody, impressions, photographs, and wax bites are taken by the forensic odontologist after informed consent is obtained or following a court order. After models are constructed, they are analyzed by the forensic odontologist, who renders an expert opinion.

### Summary

Bite marks on a conscious, unconscious, or deceased victim may furnish crucial evidence in criminal investigations. They must be preserved with accurate, properly exposed photographs, salivary swabbing using a noncontaminating technique, and through the construction of accurate models based on impressions of the bitten area. These, as well as swabbings, photographs, impressions, and models of suspects, should be obtained as soon as possible following the assault. In all cases of suspected bite mark crimes, the services of a forensic odontologist should be obtained immediately, and ideally, he should perform the procedures described above. FBI

*If the involved law enforcement agency does not already have the name of an experienced forensic odontologist, they may contact the American Academy of Forensic Sciences, 225 South Academy Blvd., Suite 201, Colorado Springs, Colo. 80910; (303) 59[illegible]-6006, for names of forensic odontologist(s) in the area.*

**Footnote**

[1] For other detailed information, see "Obtaining Saliva Samples From Bitemark Evidence," Roger Mittleman, M.D., et al., *FBI Law Enforcement Bulletin*, November 1980, p. 16.

*Figure 9*

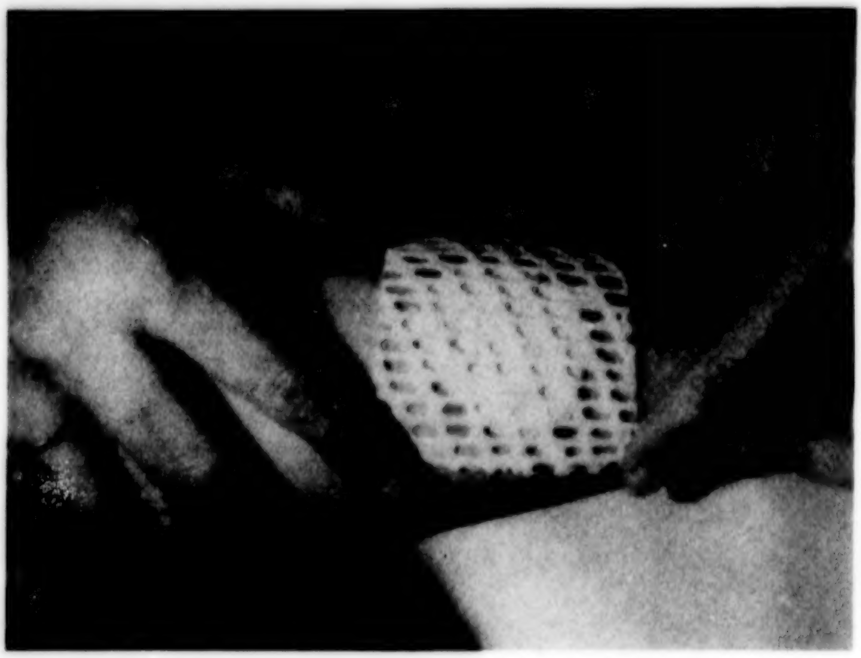


*Figure 8*

*Figure 10*

# OBTAINING SALIVA SAMPLES FROM BITEMARK EVIDENCE

By ROGER E. MITTLEMAN, M.D.
*Office of Medical Examiner*
*Miami, Fla.*

WILLARD CARL STUVER, M.S.
*Public Safety Department*
*Dade County, Fla.*

And RICHARD SOUVIRON, D.D.S., A.B.F.O.
*Dade County Medical Examiner's Office*
*Miami, Fla.*

(Published by the Federal Bureau of Investigation, U.S. Department of Justice)
Reprinted from the Law Enforcement Bulletin, November, 1980.

*EDITOR'S NOTE: This article should be of interest to all police personnel; however, only medical examiners or trained forensic technicians should attempt to obtain this type of evidence.*

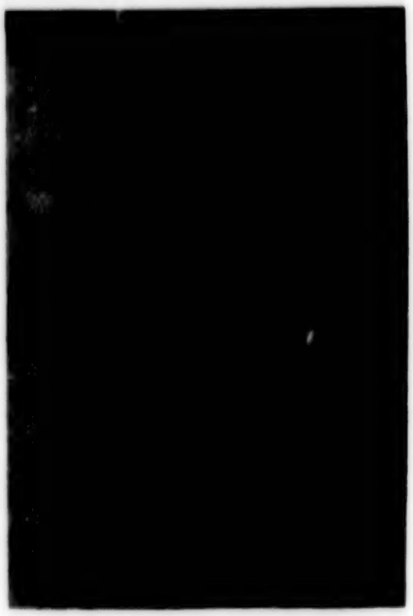
*Reference is made to a brand name applicator (Swube). This type of applicator is recommended because it has a friction cap and its design and availability lends itself to this procedure. While brand names may be mentioned in articles published in the Bulletin, this is solely for information and assistance to law enforcement personnel. It should not, under any circumstance, be construed as an endorsement or approval by the FBI.*

Bitemarks are most frequently found in violent crimes, especially those that are sex related. To aid in the possible determination of the assailant's blood type, the assailant's secretor status, and the presence or absence of salivary amylase and other proteins, saliva samples should be obtained in all suspected bitemark cases. The importance of bitemark evidence has become prominent as a result of recent trials in Florida, such as the Theodore Bundy [1] and Dorothy Haizlip [2] cases.

In the latter case, Dorothy Haizlip was found beaten and strangled in her Miami home. Bitemarks were found on her thigh and right breast. The area within the bitemark rings was swabbed and the evidence preserved. Testing of the swabbings revealed alpha amylase and the presence of the A and H antigens. The victim's serotype was blood group O. Subsequent blood and saliva standards obtained from the defendant confirmed that he was a type A secretor.

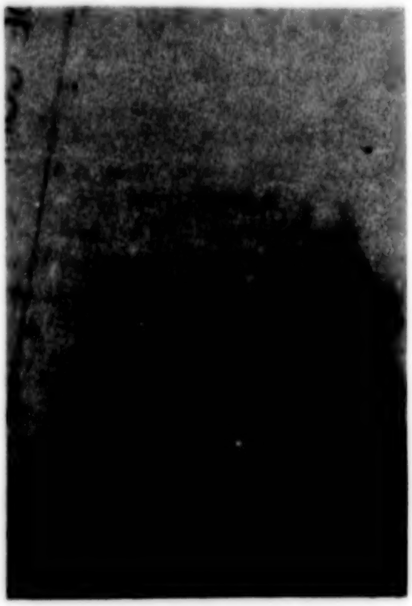
The basis for all data relative to a bitemark is the preawareness or discovery of the bitemark, followed by photography and saliva collection. Bitemarks may take many different forms, the most common being the bite "ring" made by the anterior (incisor) teeth of each arch. (See fig. 1.) Other bites may be a half ring in which only incisor teeth of the arch are present, as in the Haizlip case. (See fig. 2.) In addition, bitemarks may only be two or three teeth of an arch, not forming a bite "ring" but making more of a "tooth mark." (See fig. 3.)

*Figure 1*



*Bite ring made by anterior (incisor) teeth of each arch.*

*Figure 2*



*Half-ring bitemark (Haizlip case).*

In homicide cases, the bitemark-related samples should be collected from the victim at the crime scene; however, if the bitemark area is handled with care during transit, the evidence may be collected in the morgue. One should avoid contaminating the bitemark and should position the body so as to avoid touching the surface of the bitemark with absorbant material, such as blood, water, clothing, or paper. The preferred method is to construct a cardboard tent and secure it over and around the bitemark area with scotch tape.

A bitemark saliva collection kit should include the following equipment. (See fig. 4.)

1) Two tubes containing specially treated cotton threads (one tube labeled "control" and the other tube labeled "sample"). (See fig. 5.) The cotton threads are specially treated by thoroughly washing and rinsing a portion of 100-percent cotton sheeting. It cannot be over-emphasized that the sheeting should be thoroughly rinsed following a detergent wash because residual detergent on fabric sizing can interfere with subsequent body fluid typings, and in particular, with the salivary amylase testing. After thoroughly drying the cloth, separate (tease) eight threads approximately 12 to 15 mm long from the piece of sheeting and place them in a 1 dram shell vial. This shell vial should have a 2 to 3 mm hole melted into the plastic stopper. This hole allows the threads to air dry once they have been moistened during the swabbing process.

2) Filter paper (3 mm Whatman).
3) Labeled container for blood specimen. The container must be free of preservatives or other chemicals and must be large enough to contain at least 5 cc of blood.
4) Labeled container (squeeze bottle) for physiological saline solution.
5) One pair of clean forceps.
6) Two double Swube disposable applicators. Each double Swube disposable applicator consists of two cotton-tipped swabs in a clear plastic tube. Two labels should be included in the kit for attachment to the appropriate tube.
7) Cardboard box containing specially treated cotton cloth cut in a square, measuring approximately 3 $cm^2$. The cotton cloth is obtained from 100-percent cotton sheeting and is treated identically to the cotton threads previously described.
8) Instructions.

The saliva sample should be collected as follows:

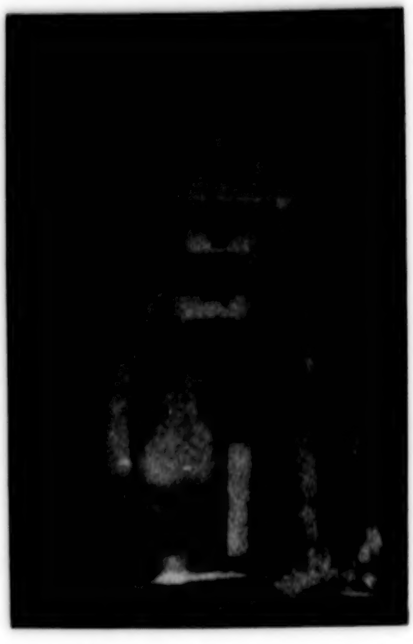
1) Using clean forceps, grasp the clump of threads from the tube labeled control. Saturate the threads with saline, shaking off the excess solution. Obtain a control sample by swabbing an area approximately 1 by 1 inch, adjacent to the bitemark but not part of it. Avoid swabbing areas contaminated by blood. Place the threads back into the control tube. The control area is sampled first so as not to contaminate the forceps with secretor material from the bitemark. The threads from the second vial are used to obtain a sample within the bitemark "ring." The sample is collected and placed in the appropriately labeled container. Care should be taken when swabbing so as not to contaminate the swabbing material with blood or inflict any extraneous wounds with the forceps. The threads must not be touched by the examiner's hands since this could result in contamination by sweat. The specimens will be used to aid in the determination of assailant blood

*Figure 3*

*Bitemark made by a few teeth (tooth marks).*

*Figure 4*

*Components of saliva kit from left to right: Plastic box with filter paper and tubes containing cotton threads, blood tube, squeeze bottle with physiological saline solutions, tweezers, Swubes, and saliva standard cardboard box with cotton cloth. (The items not pictured here are labels for the swabs and instructions.)*



*Bitemark saliva collection kit.*

*Figure 5*


*Specially treated cotton threads.*

type and secretor status in accordance with the usual forensic practices (i.e., the absorption-elution test).

2) Two cotton-tipped applicators from one of the Swube applicators should be used to reswab the area within the bitemark ring previously swabbed with threads. This is done to secure more material on a media adequate for blood typing and amylase testing. Salivary amylase (alpha amylase, AMY-1, Ec. 3.2.1.1) is commonly tested for by the starch-iodine method,[3] dyed starch substrate,[4] or electrophoretic technique.[5] Swabbing should be done by saturating the swabs with saline, draining off the excess water by gently touching it against the filter paper, rubbing thoroughly the area within the bitemark "ring," and placing the swabs into the plastic container. Remember that control swabbings must also be made of the adjacent area, using another Swube container. The samples obtained are also used to determine the assailant's blood type and secretor status by use of the absorption-inhibition tests.

3) In order to be able to interpret the results of the blood grouping tests, whole blood and saliva standards need to be collected from the victim. The cotton cloth from the box provided in the kit should be used to collect the saliva standard from the victim's mouth. The sample is obtained from the buccal mucosa, directly opposite the molar teeth on one side. If the cloth cannot be directly placed in the appropriate area, cotton swabs (Swube) may be used and pressed and rubbed against the cloth in order to transfer the control sample. The cloth is then stored in the cardboard box. Clean rubber gloves must be worn by the examiner for the collection of the saliva control. Five $cm^3$ of whole blood should be collected from the victim by an appropriate technique and placed in a sterile container that is free of preservatives and other chemicals.

The specimens should be transported to the testing laboratories (usually crime laboratories) as soon as possible after collection. If prolonged storage is anticipated, they should be placed in a cool environment (4° C). Important information can be obtained from the saliva sample which may connect a suspect to a crime. The findings can be of the utmost importance to those persons involved in prosecuting or defending these types of criminal cases.

It is important to remember that contamination of the bitemark will alter or invalidate the blood grouping and serologic studies. In addition, the bite may be made through clothing which will prevent any saliva from being deposited onto the skin, thereby giving a false negative.

The method described here is simple, convenient, and inexpensive. A complete bitemark workup could also be the key that connects a particular crime to a particular suspect. FBI

**Footnotes**

[1] *State of Florida* v. *Theodore Robert Bundy*, Leon County, Fla., Circuit Court, Case No. 78 CF-670.

[2] *State of Florida* v. *Roy Allen Stewart*, Case No. 70-6621, Circuit Court of the 11th Judicial Circuit in and for Dade County, Fla.

[3] W. Roberts, "On the Estimation of the Amglolytic and Proteolytic Activity of Pancreatic Extracts." *Proc. R. Soc.*, London 32: (1881), pp. 145-161; L. C. Nukolls, *The Scientific Investigation of Crimes* (London: Butterworth & Co., Ltd., 1956), p. 200; and D. F. Nelson and P. L. Kirk, "The Identification of Saliva," *Journal of Forensic Medicine* 10 (1963): pp. 14-21.

[4] G. M. Willott, "An Improved Test for the Detection of Salivary Amylase in Stains," *Journal of Forensic Sciences Society*, 14 (1974): pp. 341-344.

[5] J. C. Ward, A. D. Merritt and D. Bixler, "Human Salivary Amylase: Genetics of Electrophoretic Variants," *American Journal of Human Genetics*, 23 (1971): p. 403; A. D. Merritt, M. L. Rivas, D. Bixley and R. Newell, "Salivary and Pancreatic Amylase: Electrophoretics Characterizations and Genetic Studies," *American Journal of Human Genetics*, 25 (1973): p. 510

NOTES

* * * * *

# Blood Spatter Pattern Analysis

* * * * *

BLANK PAGE

FBI LABORATORY

BLOODSTAIN PATTERN ANALYSIS (BSPA)

4/89

THE LOSS OF BLOOD DURING A VIOLENT CRIME OFTEN PRODUCES BLOOD PATTERNS AND/OR SPATTER WHICH CAN PROVIDE VALUABLE INFORMATION CONCERNING THE EVENTS WHICH TOOK PLACE. THE OBJECTIVE OF THE STUDY OF BLOODSTAIN PATTERNS AND RELATED INFORMATION IS TO AS NEARLY AS POSSIBLE RECONSTRUCT THE EVENTS WHICH LED TO THE DEPOSITION OF THOSE STAINS AND STAIN PATTERNS. SUCH DATA AS SPOT SIZE, QUANTITY, SHAPE, LOCATION AND TARGET SURFACE CHARACTER MAY BE OBSERVED AND/OR MEASURED TO HELP DETERMINE:

POINTS OF ORIGIN OF SHED BLOOD
NATURE OF IMPACT OR BLOW WHICH CAUSED THE BLEEDING
NUMBER OF BLOWS, SHOTS, ETC., INVOLVED
POSITION AND MOVEMENT OF PERSONS AND OBJECTS DURING BLEEDING
VARIOUS OTHER MISCELLANEOUS INFORMATION WHICH MAY BE PERTINENT TO A SPECIFIC CASE.

THE REPRODUCIBILITY OF BLOODSTAIN PATTERNS IS NOT SIGNIFICANTLY AFFECTED BY THE AGE, SEX OR DISEASE STATE OF THE BLEEDER NOR THE ALCOHOL, DRUG OR ANTICOAGULANT CONTENT OF THE BLOOD AS LONG AS THESE SUBSTANCES ARE PRESENT IN CLINICAL AMOUNTS. TEMPERATURE AND HUMIDITY (WITHIN CERTAIN LIMITS) LIKEWISE DO NOT SIGNIFICANTLY AFFECT THE REPRODUCIBILITY OF THESE PATTERNS.

DETERMINATIONS MADE FROM BLOODSTAIN PATTERNS AT A SCENE OR FROM THE CLOTHING OF INDIVIDUALS INVOLVED IN A CASE MAY HELP TO CONFIRM OR REFUTE ASSUMPTIONS CONCERNING EVENTS AND THEIR SEQUENCE:

POSITION OF VICTIM OR SUSPECT (SITTING, STANDING, OR LYING DOWN)
EVIDENCE OF STRUGGLE (BLOOD SMEARS OR TRAILS, ETC.)
LACK OF SPATTER - VOIDS IN PATTERNS - (WAS SOMEONE OR SOMETHING BLOCKING THE SPATTER? - SUSPECT? - VICTIM?)
IN-LINE SPATTER PATTERNS (BLOOD CAST OFF FROM A BLOOD-COVERED OBJECT BEING SWUNG - THE WEAPON? - THE VICTIM?)

ADDITIONALLY, AN EXAMINER MAY BE ABLE TO CONFIRM OR REFUTE STATEMENTS MADE BY SUSPECT(S) AND/OR VICTIM(S) IN CASE:

ARE STAIN PATTERNS ON SUSPECT CLOTHING AND/OR AT THE SCENE CONSISTENT WITH HIS/HER STORY?

ARE STAIN PATTERNS ON VICTIM, VICTIM CLOTHING AND/ OR AT THE SCENE CONSISTENT WITH THE STORIES OF WITNESSES OR THE SUSPECT?

IT FOLLOWS THEN, THAT **AN EXTREMELY IMPORTANT POINT TO CONSIDER IN REQUESTING BSPA ASSISTANCE IS: BASED ON YOUR KNOWLEDGE OF THE CRIME AND THE SCENE, WHAT SPECIFIC QUESTIONS DO YOU WANT ANSWERED THROUGH BSPA EXAMINATIONS?**

WHENEVER SUCH SPATTER OR PATTERNS ARE ENCOUNTERED AT A CRIME SCENE, IT SHOULD BE RECOGNIZED THAT AN EXAMINATION OF THE AVAILABLE EVIDENCE BY A QUALIFIED LABORATORY EXAMINER MAY PRODUCE INFORMATION VALUABLE TO THE INVESTIGATION. WHEN SUCH AN EXAMINATION IS DESIRED, IT IS BEST CONDUCTED BY AN EXAMINER ON-SCENE RATHER THAN ON EVIDENCE SENT TO THE LABORATORY. FOR REASONS INVOLVING CASELOAD, EXPENSE, TIME REQUIRED, ETC., IT WILL SELDOM BE POSSIBLE TO SEND FBI LABORATORY EXAMINERS TO A CRIME SCENE.

MORE FREQUENTLY, IT WILL BE NECESSARY TO SEND EVIDENCE TO THE FBI LABORATORY FOR EXAMINATION. WHEN THIS IS DONE, AN EVALUATION OF THE MATERIALS WILL BE MADE TO DETERMINE IF A MEANINGFUL EXAMINATION CAN BE CONDUCTED ON THE AVAILABLE EVIDENCE. **IT MUST BE RECOGNIZED** THAT THIS TYPE OF EXAMINATION IS EXTREMELY TIME CONSUMING (FAR MORE SO THAN MANY OF THE MORE CONVENTIONAL SEROLOGY EXAMINATIONS) AND SHOULD NOT BE PURSUED IF THE QUESTIONS TO BE ANSWERED WILL NOT BE PROBATIVE AND PERTINENT TO THE INVESTIGATION. IF EVIDENCE IS TO BE SENT TO THE LABORATORY, THE FOLLOWING INFORMATION/MATERIALS SHOULD (WHEN POSSIBLE/APPROPRIATE) BE CONSIDERED AS VALUABLE RESOURCES FOR INFORMATION AND OBTAINED PRIOR TO THE EXAMINATION. HAVING AS MUCH AS POSSIBLE ON HAND IN ADVANCE WILL EXPEDITE MATTERS CONSIDERABLY. **TRY TO IMMAGINE YOURSELF AS KNOWING NOTHING ABOUT THE INVESTIGATION AND THINK WHAT INFORMATION WOULD HELP YOU GAIN A CLEAR PICTURE OF IT.**

1. GRAPHIC INFORMATION: SKETCHES, DIAGRAMS, MAPS (ROAD, TOPOGRAPHICAL, ETC.), BUILDING/FLOOR PLANS, OR DRAWINGS OF THE SCENE WITH DIMENSIONS AS COMPLETE AS POSSIBLE. WHEN POSSIBLE, SCALE DRAWINGS CAN BE VERY HELPFUL AND ARE PREFERRED. (SKETCHES CANNOT REPLACE PHOTOGRAPHS AND VICE VERSA.)

2. NARRATIVE INFORMATION: REPORTS (INVESTIGATIVE, MEDICAL EXAMINER'S, AUTOPSY, ETC.), PHYSICAL DESCRIPTIONS OF SUSPECT AND VICTIM (INCLUDING

RIGHT/LEFT HANDEDNESS, ASSOCIATION WITH ALCOHOL, DRUGS, MEDICATION AND INFECTIOUS DISEASES), DESCRIPTION OF THE SCENE, WEATHER CONDITIONS, ETC.

3. PHOTOGRAPHIC INFORMATION: PHOTOGRAPHS OF SCENE TAKEN BY A COMPETENT PHOTOGRAPHER WITH AS LARGE A FORMAT CAMERA AS POSSIBLE. **POLAROID OR OTHER INSTANT PRINT FORMATS SELDOM PROVIDE THE DETAIL AND INFORMATION NEEDED.** PHOTOGRAPHS SHOULD BOTH SUPPLEMENT AND COMPLEMENT SKETCHES. THE FOLLOWING GUIDELINES MAY BE HELPFUL:

PHOTOGRAPH AS SOON AS POSSIBLE PREFERABLY BEFORE ANYONE HAS HAD THE OPPORTUNITY TO CONTAMINATE THE SCENE. INCLUDE SCALES AND IDENTIFICATION DATA WHEREVER POSSIBLE.

OUTDOOR SCENE:

USE DISTANCE PHOTOS TO ESTABLISH LOCATION OF SCENE BY INCLUDING LANDMARKS.

USE MEDIUM DISTANCE PHOTOS TO RECORD RELATIVE POSITIONS OF CLOSELY RELATED ITEMS OF EVIDENCE AND LARGER STAIN PATTERNS.

USE CLOSE-UP PHOTOS OF INDIVIDUAL ITEMS TO RECORD THE NATURE OF ITEMS, HOW THEY WERE FOUND, SMALLER STAIN PATTERNS AND INDIVIDUAL STAINS.

INDOOR SCENE:

USE DISTANCE PHOTOS TO ESTABLISH LOCATION OF THE BUILDING OR STRUCTURE.

PHOTOGRAPH ROOMS AND OTHER INTERIOR AREAS FROM TYPICAL OBSERVATION POINTS WITH WIDE-ANGLE LENS TO SHOW RELATIVE POSITIONS OF ITEMS AND GENERAL STAIN PATTERNS IN THE ROOM.

MEDIUM DISTANCE PHOTOS WILL SHOW THE RELATIONSHIP OF CLOSELY RELATED ITEMS OF EVIDENCE AND STAINS OR STAIN PATTERNS.

CLOSE-UP PHOTOS SHOULD BE USED TO SHOW INDIVIDUAL ITEMS OF EVIDENCE OR

PARTICULAR STAINS AND PATTERNS FOR MEASUREMENT, IF NECESSARY.

PHOTOS OF STAINS AND STAIN PATTERNS:

TAKE PHOTOS PERPENDICULAR TO SURFACE BEARING THE STAIN OR PATTERN AND INCLUDE A REFERENCE SCALE (MILLIMETERS PREFERRED) IN PHOTO. (CAUTION: FLASH USED TOO CLOSE WILL WASH OUT DETAIL IN THE STAIN PATTERNS.)

4. PHYSICAL EVIDENCE: IT MAY BE NECESSARY TO COLLECT, PACKAGE AND SECURE ITEMS OF PHYSICAL EVIDENCE (CLOTHING, WEAPONS, ETC.) CONTAINING BLOOD OR TRACE EVIDENCE TO PREVENT LOSS. WHEN POSSIBLE, THE ENTIRE SCENE SHOULD BE SECURED WITH AS LITTLE DISTURBANCE AS POSSIBLE UNTIL BSPA EXAMINATIONS CAN BE COMPLETED.

5. BLOODSTAIN LIFTS: LIFTS OF BLOODSTAINS FOR FUTURE EXAMINATION SHOULD BE DONE ONLY BY OR WITH THE SPECIFIC ADVICE OF AN INDIVIDUAL TRAINED AND EXPERIENCED IN BSPA EXAMINATIONS.

WHILE THE ABOVE MATERIALS IN SOME INSTANCES REPRESENT CONSIDERABLE DETAIL, EFFORT SHOULD BE MADE TO ASSEMBLE AS MUCH INFORMATION AS POSSIBLE TO AID AND EXPEDITE SCENE INTERPRETATION. EVIDENCE SHOULD BE FORWARDED TO THE LABORATORY AS SOON AS POSSIBLE (ALLOWING FOR PROPER HANDLING OF WET EVIDENCE, DRYING, ETC.).

# Appendix 2

## *Impact Angle Determinations*

In Experiment 4 one of the methods of determining the impact angle of a blood drop was based on the trigonometric relationship:

$$\frac{\text{Width of Stain}}{\text{Length of Stain}} = \text{Sine of Impact Angle}$$

Thus, by locating the width-to-length ratio of the bloodstain in the following sine table, the angle of impact of the drop causing the stain can be obtained directly.

TRIGONOMETRIC TABLES - SINE FUNCTION

| DEGS | 0.0° | 0.1° | 0.2° | 0.3° | 0.4° | 0.5° | 0.6° | 0.7° | 0.8° | 0.9° |
|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.0000 | 0.0017 | 0.0035 | 0.0052 | 0.0070 | 0.0087 | 0.0105 | 0.0122 | 0.0140 | 0.0157 |
| 1 | 0.0175 | 0.0192 | 0.0209 | 0.0227 | 0.0244 | 0.0262 | 0.0279 | 0.0297 | 0.0314 | 0.0332 |
| 2 | 0.0349 | 0.0366 | 0.0384 | 0.0401 | 0.0419 | 0.0436 | 0.0454 | 0.0471 | 0.0488 | 0.0506 |
| 3 | 0.0523 | 0.0541 | 0.0558 | 0.0576 | 0.0593 | 0.0610 | 0.0628 | 0.0645 | 0.0663 | 0.0680 |
| 4 | 0.0698 | 0.0715 | 0.0732 | 0.0750 | 0.0767 | 0.0785 | 0.0802 | 0.0819 | 0.0837 | 0.0854 |
| 5 | 0.0872 | 0.0889 | 0.0906 | 0.0924 | 0.0941 | 0.0958 | 0.0976 | 0.0993 | 0.1011 | 0.1028 |
| 6 | 0.1045 | 0.1063 | 0.1080 | 0.1097 | 0.1115 | 0.1132 | 0.1149 | 0.1167 | 0.1184 | 0.1201 |
| 7 | 0.1219 | 0.1236 | 0.1253 | 0.1271 | 0.1288 | 0.1305 | 0.1323 | 0.1340 | 0.1357 | 0.1374 |
| 8 | 0.1392 | 0.1409 | 0.1426 | 0.1444 | 0.1461 | 0.1478 | 0.1495 | 0.1513 | 0.1530 | 0.1547 |
| 9 | 0.1564 | 0.1582 | 0.1599 | 0.1616 | 0.1633 | 0.1650 | 0.1668 | 0.1685 | 0.1702 | 0.1719 |
| 10 | 0.1736 | 0.1754 | 0.1771 | 0.1788 | 0.1805 | 0.1822 | 0.1840 | 0.1857 | 0.1874 | 0.1891 |
| 11 | 0.1908 | 0.1925 | 0.1942 | 0.1959 | 0.1977 | 0.1994 | 0.2011 | 0.2028 | 0.2045 | 0.2062 |
| 12 | 0.2079 | 0.2096 | 0.2113 | 0.2130 | 0.2147 | 0.2164 | 0.2181 | 0.2198 | 0.2215 | 0.2232 |
| 13 | 0.2250 | 0.2267 | 0.2284 | 0.2300 | 0.2318 | 0.2334 | 0.2351 | 0.2368 | 0.2385 | 0.2402 |
| 14 | 0.2419 | 0.2436 | 0.2453 | 0.2470 | 0.2487 | 0.2504 | 0.2521 | 0.2538 | 0.2554 | 0.2571 |
| 15 | 0.2588 | 0.2605 | 0.2622 | 0.2639 | 0.2656 | 0.2672 | 0.2689 | 0.2706 | 0.2723 | 0.2740 |
| 16 | 0.2756 | 0.2773 | 0.2790 | 0.2807 | 0.2823 | 0.2840 | 0.2857 | 0.2874 | 0.2890 | 0.2907 |
| 17 | 0.2924 | 0.2940 | 0.2957 | 0.2974 | 0.2990 | 0.3007 | 0.3024 | 0.3040 | 0.3057 | 0.3074 |
| 18 | 0.3090 | 0.3107 | 0.3123 | 0.3140 | 0.3156 | 0.3173 | 0.3190 | 0.3206 | 0.3223 | 0.3239 |
| 19 | 0.3256 | 0.3272 | 0.3289 | 0.3305 | 0.3322 | 0.3338 | 0.3355 | 0.3371 | 0.3387 | 0.3404 |
| 20 | 0.3420 | 0.3437 | 0.3453 | 0.3469 | 0.3486 | 0.3502 | 0.3518 | 0.3535 | 0.3551 | 0.3567 |

| DEGS. | 0.0° | 0.1° | 0.2° | 0.3° | 0.4° | 0.5° | 0.6° | 0.7° | 0.8° | 0.9° |
|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 0.3584 | 0.3600 | 0.3616 | 0.3633 | 0.3649 | 0.3665 | 0.3681 | 0.3697 | 0.3714 | 0.3730 |
| 22 | 0.3746 | 0.3762 | 0.3778 | 0.3795 | 0.3811 | 0.3827 | 0.3843 | 0.3859 | 0.3875 | 0.3891 |
| 23 | 0.3907 | 0.3923 | 0.3939 | 0.3955 | 0.3971 | 0.3987 | 0.4003 | 0.4019 | 0.4035 | 0.4051 |
| 24 | 0.4067 | 0.4083 | 0.4099 | 0.4115 | 0.4131 | 0.4147 | 0.4163 | 0.4179 | 0.4195 | 0.4210 |
| 25 | 0.4226 | 0.4242 | 0.4258 | 0.4274 | 0.4289 | 0.4305 | 0.4321 | 0.4337 | 0.4352 | 0.4368 |
| 26 | 0.4384 | 0.4399 | 0.4415 | 0.4431 | 0.4446 | 0.4462 | 0.4478 | 0.4493 | 0.4509 | 0.4524 |
| 27 | 0.4540 | 0.4555 | 0.4571 | 0.4586 | 0.4602 | 0.4617 | 0.4633 | 0.4648 | 0.4664 | 0.4679 |
| 28 | 0.4695 | 0.4710 | 0.4726 | 0.4741 | 0.4756 | 0.4772 | 0.4787 | 0.4802 | 0.4818 | 0.4833 |
| 29 | 0.4848 | 0.4863 | 0.4879 | 0.4894 | 0.4909 | 0.4924 | 0.4939 | 0.4955 | 0.4970 | 0.4985 |
| 30 | 0.5000 | 0.5015 | 0.5030 | 0.5045 | 0.5060 | 0.5075 | 0.5090 | 0.5105 | 0.5120 | 0.5135 |
| 31 | 0.5150 | 0.5165 | 0.5180 | 0.5195 | 0.5210 | 0.5225 | 0.5240 | 0.5255 | 0.5270 | 0.5284 |
| 32 | 0.5299 | 0.5314 | 0.5329 | 0.5344 | 0.5358 | 0.5373 | 0.5388 | 0.5402 | 0.5417 | 0.5432 |
| 33 | 0.5446 | 0.5461 | 0.5476 | 0.5490 | 0.5505 | 0.5519 | 0.5534 | 0.5548 | 0.5563 | 0.5577 |
| 34 | 0.5592 | 0.5606 | 0.5621 | 0.5635 | 0.5650 | 0.5664 | 0.5678 | 0.5693 | 0.5707 | 0.5721 |
| 35 | 0.5736 | 0.5750 | 0.5764 | 0.5779 | 0.5793 | 0.5807 | 0.5821 | 0.5835 | 0.5850 | 0.5864 |
| 36 | 0.5878 | 0.5892 | 0.5906 | 0.5920 | 0.5934 | 0.5948 | 0.5962 | 0.5976 | 0.5990 | 0.6004 |
| 37 | 0.6018 | 0.6032 | 0.6046 | 0.6060 | 0.6074 | 0.6088 | 0.6101 | 0.6115 | 0.6129 | 0.6143 |
| 38 | 0.6157 | 0.6170 | 0.6184 | 0.6198 | 0.6211 | 0.6225 | 0.6239 | 0.6252 | 0.6266 | 0.6280 |
| 39 | 0.6293 | 0.6307 | 0.6320 | 0.6334 | 0.6347 | 0.6361 | 0.6374 | 0.6388 | 0.6401 | 0.6414 |
| 40 | 0.6428 | 0.6441 | 0.6455 | 0.6468 | 0.6481 | 0.6494 | 0.6508 | 0.6521 | 0.6534 | 0.6547 |
| 41 | 0.6561 | 0.6574 | 0.6587 | 0.6600 | 0.6613 | 0.6626 | 0.6639 | 0.6652 | 0.6665 | 0.6678 |
| 42 | 0.6691 | 0.6704 | 0.6717 | 0.6730 | 0.6743 | 0.6756 | 0.6769 | 0.6782 | 0.6794 | 0.6807 |
| 43 | 0.6820 | 0.6833 | 0.6845 | 0.6858 | 0.6871 | 0.6884 | 0.6896 | 0.6909 | 0.6921 | 0.6934 |
| 44 | 0.6947 | 0.6959 | 0.6972 | 0.6984 | 0.6997 | 0.7009 | 0.7022 | 0.7034 | 0.7046 | 0.7059 |
| 45 | 0.7071 | 0.7083 | 0.7096 | 0.7108 | 0.7120 | 0.7133 | 0.7145 | 0.7157 | 0.7169 | 0.7181 |
| 46 | 0.7193 | 0.7206 | 0.7218 | 0.7230 | 0.7242 | 0.7254 | 0.7266 | 0.7278 | 0.7290 | 0.7302 |
| 47 | 0.7314 | 0.7325 | 0.7337 | 0.7349 | 0.7361 | 0.7373 | 0.7385 | 0.7396 | 0.7408 | 0.7420 |
| 48 | 0.7431 | 0.7443 | 0.7455 | 0.7466 | 0.7478 | 0.7490 | 0.7501 | 0.7513 | 0.7524 | 0.7536 |
| 49 | 0.7547 | 0.7559 | 0.7570 | 0.7581 | 0.7593 | 0.7604 | 0.7615 | 0.7627 | 0.7638 | 0.7649 |
| 50 | 0.7660 | 0.7672 | 0.7683 | 0.7694 | 0.7705 | 0.7716 | 0.7727 | 0.7738 | 0.7749 | 0.7760 |
| 51 | 0.7771 | 0.7782 | 0.7793 | 0.7804 | 0.7815 | 0.7826 | 0.7837 | 0.7848 | 0.7859 | 0.7869 |
| 52 | 0.7880 | 0.7891 | 0.7902 | 0.7912 | 0.7923 | 0.7934 | 0.7944 | 0.7955 | 0.7965 | 0.7976 |
| 53 | 0.7986 | 0.7997 | 0.8007 | 0.8018 | 0.8028 | 0.8039 | 0.8049 | 0.8059 | 0.8070 | 0.8080 |
| 54 | 0.8090 | 0.8100 | 0.8111 | 0.8121 | 0.8131 | 0.8141 | 0.8151 | 0.8161 | 0.8171 | 0.8181 |

NOTES

* * * * *

# Homicide by Poison

* * * * *

Alphonse Poklis, Ph.D.
Director of Toxocology
Medical College of Virginia

# HOMICIDE INVESTIGATION: DEATH DUE TO POISONING

Determining that a person has died as the result of homicidal poisoning is the most difficult type of investigation for law enforcement officers and medical experts. The general evidence of poisoning is obtained from a knowledge of the symptoms displayed by the decedent prior to death, the post mortem examination of the body by the pathologist, and the isolation and identification of the poison by the toxicologist. For successful prosecution of a suspect, law enforcement officers must establish a motive for the crime, access of the perpetrator to a supply of the poison, that he was aware of the lethal effects of the poison and had opportunities to administer the poison to the decedent. Each aspect of the investigation are dealt with in outline form below.

I. Lack of Suspicion:

A. When the victim is attended prior to death by a physician, the doctor seldom, if ever, considers poisoning as a cause of the patient's ills. Only if the patient's occupation brings him into contact with toxic substances (works in a refinery, chemical or smelting plant; farmer who uses pesticides or herbicides); will the physician suspect a chemical intoxication.

B. Self-poisoning (suicides or drug abuse) is common today; however, murder by poison is rare.

C. Person who resort to the use of poisons are usually very stupid or very clever. The stupid ones make obvious their crimes, the clever ones may never be unmasked.

II. Signs and Symptoms Prior to Death:

A. There is rarely any symptom of poisoning which cannot equally well be caused by disease; however, there are conditions or symptoms which render a diagnosis of poisoning moderately certain. For example, the onset of symptoms immediately after eating or drinking, a progression of symptoms and rapid death indicate acute poisoning. (Bacterial food poisoning has a delayed onset of symptoms).

Table 1. Symptoms which may Indicate Poisoning or a Pathological Condition

| Symptom | Poison | Disease |
|---|---|---|
| Vomiting, Diarrhea, Rapid Collapse, Weak Pulse | Arsenic | Rupture of Gastric Ulcer, Inflammation of the Pancreas or Appendix |
| Convulsions | Strychnine | Tetanus |
| Contracted Pupils, Narcosis | Narcotics | Brain Lesions |

B. If medical assistance is called prior to death, the following should be noted:

1. Time medical personnel arrived.

2. The signs and symptoms of intoxication;
   a) condition of the pupils
   b) pulse and respiratory rate
   c) convulsions or paralysis
   d) stomach pain

3. Time the symptoms started and <u>their order</u>.

4. Smell and color of the subject's vomit, odor of breath.

5. Time of death.

6. All statements made by the victim.

III. Evidence:

A. From the victim's residence and/or from witnesses obtain the following information:

1. All substances, food and drink, which the decrease ingested 24 hours prior to the onset of symptoms. <u>If still available, collect all such items</u>.

2. Time of last meal or drink.

3. The state of health of the victim prior to the onset of symptoms.

4. Did others who shared the deceased's last meal become sick; if so, what were the symptoms.

5. Had the subject ever attempted suicide (Suicide Defense).

6. Where were poisons and medicines kept.

7. Inquire of the victim's personal physician all pertinent medical information.

B. Collection of Evidence at the Scene:

*Remember that in all legal cases it is essential that the proper chain of custody of evidence be maintained. Conduct a complete and thorough search of the premises where the deceased was found and collect the following:

1. Collect all medicine bottles, hyperdermic syringes, etc.

2. All empty, partially empty or opened containers of poisons or medicines.

3. All foot the victim may have recently eaten. Place each item in a separate clean glass contain container (rinse the container with water prior to use and submit a sample of the rinse water to the laboratory with the samples), close and seal, and label.

4. All utensils, pates, cuts, etc. used for recent eating and drinking.

5. Garbage left from the victim's last meal.

6. Vomit, urine, excretion of the victim prior to death.

7. Soiled linen or clothes of the deceased.

IV. Post Mortem Examination of Body:

A. The pathologist can recognize the effects of certain poisons at autopsy. Strong acids and alkalies may cause extensive burns around mouth or on the surface of the body and severe destruction of the tissues. Metallic poisons may cause intensive damage to the gastrointestinal tract, liver and kidneys. Phosphorous causes gross fatty degeneration of the liver.

B. Most drugs and poisons do not produce characteristic pathological lesions, and can only be demonstrated in the body by toxicologic analysis.

C. In many instances of poisoning, the value of the pathologist's examination is the establishment that death was not due to natural causes or traumatic injury, that there is no evidence for death except from possible poisoning.

V. Toxicologic Examination:

A. Death due to poisoning can not be established without contention unless the agent can be demonstrated in the body by chemical methods of isolation and identification.

B. The stomach and the intestines are "legally" considered outside the body. The presence of the poison must be established in blood, liver or other tissues in the body.

C. The presence of a poison in urine only indicates that it was at sometime present in the body; the significance of urine levels is subject to question.

D. There are thousands of compounds which are lethal if ingested and the toxicologist has only a limited amount of material on which to perform his analysis; therefore, it is imperative that the investigators supply the toxicologist with as much information as possible concerning the facts of the case. The possible identity of the poison in question would greatly help!

E. Embalming and putrefaction may greatly hinder the toxicologist in his work.

F. Many poisons are rapidly biotransformed or excreted by the body; in such cases only the biotransformation products (metabolities) or low levels of the poisons maybe detected.

G. Many poisons can be detected for many years after death. (Arsenic)

VI. Collection and Preservation of Specimens:

A. All specimens; whether food or garbage, or tissues obtained at autopsy should be placed in separate containers. Glass jars with screw tops (mason jars) or plastic bags are acceptable.

B. Each container should be labeled and the identification should bear the date and time of collection, the name of the victim, the identity of the sample and the signature of the law enforcement personnel or pathologist.

C. All containers should be sealed and initialed by the person collecting the sample.

D. When exhibits are handled by several persons and when they are accepted by the analyst, it is essential to get a written receipt for them, which can subsequently be produced in court.

NOTES

NOTES

* * * * *

# Asphyxial Deaths

* * * * *

# ASPHYXIAL DEATHS

Arthur Westveer
F.B.I. Academy
Quantico, Virginia

## ASPHYXIAL DEATHS

1. Definition

   Any condition by which the body or a vital part is deprived of oxygen.

2. *Tissues of the body cannot function without oxygen. Subnormal amounts of oxygen in the blood supply to the brain causes rapid unconsciousness. The brain is most sensitive to oxygen deprivation and is intimately effected in all types of asphyxial deaths.

3. Types of asphyxia

   A. Natural
   B. Compression of the neck
   C. Obstruction of the airway
   D. Compression of the chest
   E. Depletion of replacement
   F. Chemical - intoxication

4. *Manner of Death
   Natural - Heart Failure
   Pneumonia - disease
   Interfere with oxygen supply
   Predominately in area of lungs
   Accidental allergic reaction to shell fish, bee sting, medication

5. Diagram of cross section of throat

6. Diagram - Cutaway of skull

7. *Amount of pressure required to cause asphyxia.

| | |
|---|---|
| Jugular vein | 4-5 lbs. |
| Carotid Arteries | 11 lbs. |
| Trachea | 35 lbs. |
| Vertebral arteries | 66 lbs. |

8. *After pressure is applied, unconsciousness supervenes in a matter of seconds

   Heart may continue to beat for 15-20 minutes.

9. *Blood supply to brain and airway and both obstructed in hangings.

   Exceptions

10. *Hanging
    Requires suspension or partial suspension of the body with a ligature attached to a fixed point. Body weight provides restricting force. Total suspension not necessary.

Furrow tends to angel towards point of suspension maybe abrasions or contusions due to scraping of ligature or by instinctive reactions by victim to gain release.

Fingers - may be trapped under ligature - not to be confused with manual strangulation.

11. *Protruding of tongue
Pressure on base of neck and region of attachment of tongue may cause lower jaw to drop open and tongue to protrude between the teeth, will dry and become dark with exposure.

12. *Face may be congested (cyanosis) or pale usually pale - blood not restricted to head by ligature after circulation ceases.

13. *Petechial Hemorrhage
Observed in face and conjuncture of eye. Mucous membrane of mouth and throat.

14. *Judicial type hanging
Requires a fall and sudden stop
Cause of death is fractures of the cervical vertebrae which causes pressure on vital nerve centers to brain which control respiration and heartbeat death is instantaneous

## INTERNAL BLEEDING

15. Hanging
Focal hemorrhage uncommon -
involving a fall - some tearing of internal muscles, organs, and blood vessels may occur

16. *Fractures of bone or cartilage
Hanging
Rare except in judicial type where a fall is present

17. *Ligature Strangulation
    1. Hemorrhage may be present between strap muscles and ligature
    2. Abrasions may be present due to struggle or by victim efforts to free ligature.
    3. Furrow or groove will usually be lower than that of a hanging and will usually be horizontal

18. Strangulation
Compression of neck structures without suspension of the body
With hands - throttling
With Arm - yoking
With ligature - Garroting

19. Choking
    Blockage of the internal airway by a foreign object

20. Accidental
    Adults in restaurants (cafe coronary)
    or in Hospitals
    Children - marbles, balloons

21. Smothering
    Blockage of the external airway
    Noise and mouth

22. Mechanisms
    Hands, pillow, plastic bag, gag

23. *Compression of Chest
    1. Usually traumatic
    2. In order for air exchange occur, the volume of the chest cavity must increase to let the air in. If the chest is compressed the normal mechanism for respiration cannot occur.

24. *Depletion or replacement of oxygen
    1. Sudden loss of cabin pressure at high altitude.
    2. Consumption of available oxygen in sealed space.
    3. Displacement of oxygen heavier gas.

25. *Chemical intoxication
    Can also deprive the body of oxygen
    1. Carbon monoxide
    2. Cyanide
    3. Depressants

26. *Cyanide Intoxication
    Chemical reaction of body cells which prevents them from utilizing the oxygen carried to them by the blood.

27. *Carbon Monoxide
    Deprives the body of oxygen by restricting the ability of the red blood cells to carry oxygen to the tissues of the body turns the skin cherry-red.

28. *Depressants
    Alcohol opiates, barbiturates inhibit the respiratory center causing respiratory depression, breathing slows, then stops, resulting in an asphyxial death.

# DEATHS FROM ASPHYXIA

by

James L. Luke, M.D.

# DEATHS FROM ASPHYXIA

The term asphyxia is used rather loosely by forensic pathologists to connote a pathophysiological situation where the supply of oxygen to the blood or other bodily tissues has been compromised to the extent that death ensues. It may be conceptualized as a condition where the cellular tissues are prevented from receiving oxygen due to primary interference with the transportation of oxygen from outside the body through the lungs (mechanical asphyxia) or through the blood to the cellular tissues (chemical asphyxia).

Accordingly, one can consider asphyxia to be either mechanical or chemical in nature.

It should be understood that many deaths resulting from commonly accepted asphyxial modalities occur with such rapidity that other physiological mechanisms (e.g., cardiac arrhythmia) must be invoked in addition to asphyxia, adequately to explain the specific pathogenesis of such fatalities.

## I. Mechanical Asphyxia

In medical-legal situations, asphyxial fatalities are usually associated with mechanical interference with adequate ventilation. Examples are suffocation, strangulation, choking, drowning, and mechanical fixation of the thorax ("traumatic asphyxia").

The anatomic signs of mechanical asphyxia are highly variable and substantially reflect the particular circumstances of the fatal event. Cyanosis, petechial hemorrhages and vascular engorgement of internal viscera are some of the common findings one might expect to see in a death from mechanical asphyxia. The extreme subtlety of anatomic correlates of this sort cannot be overemphasized. They must be actively looked for to be found. However, by themselves, these postmortem findings are merely that - "findings", which must mesh with the circumstances of death in order for the investigator to develop a realistic appraisal of cause and manner and of the specific circumstances surrounding a given death. Examples of the latter would include such parameters as a missing wallet, personal situations implying nepharious motivation (recently purchased life insurance, for example), opportunity and/or access to the victim, anatomic evidence of sexual assault, among a host of other possible considerations.

In addition, the inflicting agent such as the perpetrator's hands or a rope or other ligature which may have generated the mechanical pressure causing asphyxia, might be expected to leave certain significant residua on the body of the victim. Curvilinear scratches or abrasions on the neck may be seen (from fingernails in manual strangulation, for example). The characteristic deeply grooved furrowed abrasions of the constricting ligature instrument is usually seen in cases of hanging. An abrasion or small laceration at the outer aspect of the lip or chin may represent force exerted by a hand pressed forcibly over the mouth. The changes noted in such cases, though subtle, are valuable in the extreme.

However, these signs may be obscured by the presence of pre-existing natural disease, by the position in which the body had lain after death, by postmortem autolysis and putrifaction, or by the fact that the assailant applied gentle force sufficient to kill but insufficient to leave any trace upon the body.

A. Postmortem Signs of Asphyxia

1. Petechial hemorrhages -

Distribution in order of decreasing frequency:

Conjunctival mucosa
Skin of face and orbits
Laryngeal mucosa
Galea
Buccal mucosa
Visceral surfaces (pleura, epicardium)

Rarely seen in children, and practically never in infants, no matter what mode of asphyxia has been employed.

Commonly observed in individuals found in the prone position and dying of various modalities, both natural and unnatural.

Rapidly erased or obscured by postmortem decomposition.

Seen in ligature strangulation > manual strangulation > smothering.

Less frequently observed in hanging than strangulation, probably via complete and simultaneous arterial and venous occlusion in the former instance, and directly related to degree of suspension of body.

2. <u>Trauma to skin of neck</u>

   a) Curvilinear abrasions ("fingernail" abrasions). Most commonly seen in manual strangulation, by definition.

   b) Ligature abrasion/furrow. Horizontally situated in ligature strangulation. Canted (with apex lateral) in hanging. Patterned blanching of lividity may replicate ligature instrument. Rarely seen in yoking or garroting.

3. <u>Trauma to skin of nose</u>. Abrasions/contusions of nasal alae.

4. <u>Trauma to internal structures of neck</u>.

   a) Strap muscle hemorrhage.

   b) Fractures of thyroid and cricoid cartilages and/or hyoid bone.

   c) Contusions of intrinsic musculature of larynx.

Commonly seen in manual and ligature strangulation. Much less frequent in hanging.

Fractures common in adults (males over 30-35 years, females over 40 years, for instance), unusual in adolescents and extremely rare in children.

NOTE: It is imperative that the anatomic structures of the neck be dissected and removed <u>by the prosector</u> in the most careful manner possible, only <u>after</u> pathologic examination of the thoracic and intracranial contents has been accomplished. Strap muscles should be dissected in layers. The larynx should be opened posteriorly for internal examination only <u>after</u> the intrinsic musculature overlying the anterior and posterior aspects of the cricoid cartilage has been removed. In this regard, the mucosa of the posterior larynx, including that overlying the thyroid cornua, must be removed for adequate examination of the underlying cartilage and intrinsic muscular tissues. The hyoid bone and its attached cornua should be evaluated for fractures only <u>after</u>

careful scraping of the attached musculature to expose the periostium. These procedures should be effected in every medical-legal autopsy, no matter what the presumed cause and manner of death might be. Finally, manual palpation of the hypopharynx should be effected, in the event that an obstructing foreign object has been moved cephalad incident to removal of the airway structures themselves.

B. Types of Mechanical Asphyxia

1. Smothering (suffocation) is the term used when the passage of air through the mouth and nose is blocked or when the oral pharynx is occluded. Mechanisms necessary to accomplish this end may vary from a hand (usually both hands), to a forcibly compressed pillow over the face, a plastic bag, or a gag or other obstructive vehicle. It may be effected when dirt, sand, or other powdery or fine substance occludes the nose and mouth and/or airway. Many of the latter types of situations are accidental in origin, industrial cave-ins, for example.

It should be understood that it is not exclusively the impacting material itself that compromises air exchange but saturation of the material (the cloth of a handkerchief gag, for example) with saliva that occludes the upper respiratory tract. It is possible to breathe through a dry folded washtowel or an uncompressed pillow, but when such objects become moistened and/or compressed, air exchange may be severely restricted.

Autopsy findings in medical-legal cases of these types are often minimal, being restricted to the occluding material, and petechial hemorrhages in the distribution noted. The latter are, in my experience, abundant in gag-type situations but are minimal in all others. Lipstick or blood smeared upon a pillow may furnish a significant clue to the terminal event.[1,2]

2. Manual and/or Ligature Strangulation and Yoking

The only way to differentiate these first two modes of occurrence is by the finding of curvilinear abrasions ("fingernail abrasions") in the former and a ligature or ligature imprint

---

[1]J.L. Luke, The Pathology, Diagnosis and Certain Medical-Legal Aspects of Death by Homicidal Smothering in Adults, Legal Medicine Annual-1971, Edited by Cyril H. Wecht, M.D., New York, Appleton-Century-Crofts, 1971, pp. 29-42, 1971.

[2]J.L. Luke, Recovery of Intact Respiratory Epithelium from a Cloth Pillowcase Four Days Following its Utilization as a Smothering Instrument, J. For. Sci., 14: 398-401. 1969.

in the latter. In addition, a plethora of petechial hemorrhages is commonly appreciated in cases of ligature strangulation, so much so that the orbital skin may give the appearance of a reddish "blush". Manual stretching of the orbital skin tissues in such cases will usually identify the myriad of individual petechial hemorrhages. In my experience, subjacent trauma to the laryngeal apparatus and overlying strap muscles is somewhat more extensive in cases of manual than ligature strangulation. Once again, petechial equivalents of asphyxia are unusual in children and rare indeed in infants; fractures are only occasionally seen in young adults and almost never in children.

Yoking (the anterior compression of the neck by a forearm from behind) only rarely leaves any appreciable trauma on the anterior skin surfaces of the neck. The "development" of bruises or contusions of the neck may take place within 12-36 hours after the event (i.e., postmortem). Massive internal injury to the laryngeal apparatus and strap muscles may be observed without any external evidence of trauma. Petechial hemorrhages may be absent in such cases.[3]

### 3. Hanging

Cases of hanging are most commonly suicidal in origin, although notes reflecting the intent of the victim are recovered in only 10-15% of such cases, somewhat less frequently than in many other forms of suicide. Many hanging victims are of middle European or Spanish-American extraction. Complete suspension is not a pre-requisite to achieving death by this mechanism. Partial suspension with the majority of the body weight supported by the ligature will effect the required result. The ligature in most cases is a slip-knotted structure and varies with the availability of suitable material; rope, electrical cord, bed sheeting, knotted slacks, etc.

Auto-erotic sexual hanging cases generally involve adolescents or young adults, a cloth interface between the ligature and the skin surface, unzipped trousers, the presence of male ejaculate, pornographic literature and other "unusual" material being common correlates of this syndrome.

As noted above, petechial hemorrhages and internal trauma to the neck are relatively unusual anatomic findings in cases of hanging and depend on degree of suspension.[4] The more complete the suspension, the less the findings.

---

[3] J.L. Luke, Strangulation as a Method of Homicide in New York City, A.M.A. Archives of Pathology, 83:64-70, 1967.

[4] J.L. Luke, Asphyxial Death by Hanging in New York City, 1964-1965. J. For. Sci., 12:359-369, 1967.

Homicidal hanging is distinctly rare. The four cases of homicide that presented as suicidal hanging deaths investigated by the Office of the Chief Medical Examiner in Washington, D. C. over the past several years all involved females. None was completely suspended. One such case involved a 28 year old female who was found on the floor of her apartment with a knotted strip of bed sheet fastened to her neck, the other end being attached to a wooden curtain rod that had been pulled from the wall. The deceased was partially dressed. Because of the extensive nature of the external and internal trauma of the neck found at autopsy, coupled with the presence of sperm identified on examination of the vaginal aspirate (the victim was known not to have any male companions) and her missing wallet, the death was certified as having resulted from manual strangulation. A palm print of the perpetrator was recovered from the Sunday newspaper found underneath the body. Moral - "hanging" cases of partially suspended females should be examined and investigated in the most careful fashion.

Finally the past tense of the verb hang is hanged, not "hung". Bulls and men are hung.

4. Choking

This condition denotes the blocking of the internal airway by a foreign object. Contrary to popular opinion, the obstructing bolus is not usually inhaled but, because of its large size, is impacted at the posterior hypopharynx, mechanically occluding not only the upper esophagus but the glottis as well. Consequently, the victim is able to exhale adequately but cannot inhale, thereby collapsing (while eating), commonly without uttering a sound.

Most such individuals are considered to have died from a cardiac arrhythmia; hence the moniker "cafe coronary". In some cases the victim will have been removed forcibly from the restaurant, having collapsed "in his soup", as it were, as a public drunk. And drunk he usually is, as are the vast majority of adult choking deaths. The second most common group affected by this condition are children who inhale food and other foreign objects (balloons, marbles, etc.) at the dinner table or at play. (A convenient way to certify deaths of this type is "Asphyxia by Choking on Bolus of _______", iambic tetrameter at its best). Obviously, any death that occurs during the course of eating must be autopsied to rule out a bolus or aspiration-type of situation, and such fatalities are to be classified as having occurred by accidental means.

5. Traumatic Asphyxia

This is the term applied to death following mechanical compression of the chest. When the external thoracic pressure is extreme, the face and neck may be intensely cyanotic and congested, with numerous Tardieu spots and petechiae of the peripherally compressed skin being found. Diffuse and bilaterally symmetrical subconjunctival hemorrhage is common. In other cases, fixation of the rib cage may be only sufficient to prevent adequate respiratory excursion, but without severe compression. Under the latter circumstance, autopsy findings following removal of the victim from his predicament may be almost totally negative from the standpoint of the effect of external pressure. It is apparent that a very careful scene investigation must be conducted in such situations in order to elucidate the correct facts of the case and, in many instances, to effect remedy of a gross safety hazard when, for example, such deaths occur during the course of employment.

Positional asphyxia, an antiquated term, implies external or internal airway occlusion, the latter by tracheal kinking and/or passive elevation of the tongue into the posterior hypopharynx. In the past this mode of death was hypothesized most commonly to explain death among acute alcoholics or other severely intoxicated or sedated persons. However, with further elucidation of the pathophysiology of central nervous system depression caused by such agents, deaths of this type have become distinctly unusual. Fortunately, the human respiratory tract is structured to maintain patency, which it does under virtually all circumstances of passive compromise. Deaths which used to be considered to have resulted from positional asphyxia are now thought to result from the pharmacological effects of the depressant drug involved.

6. Drowning

This term is used when a fluid substance is inhaled, blocking the airway by respiratory-excursion-generated foam, by the mixing of respiratory air with the aspirated liquid. Drowning may be extremely rapid, with fatal unconsciousness ensuing within the span of several minutes. Most such deaths result from cardiac arrhythmia incident to rapid fluid/electrolyte shifts (hemolysis-derived-hyperkalemia in fresh water drowning, for example) and not exclusively from asphyxia. The autopsy findings here may be quite variable and depend on the physical condition of the victim, postmortem changes occasioned by putrifaction or resuscitation, and other parameters.

There is no definitive anatomic correlate of drowning, a diagnosis which depends significantly on the circumstances of the finding of a submerged body. Temporal bone and middle ear

hemorrhages are not infrequently seen in cases of drowning but are also observed in a host of other situations including extreme visceral congestion, victims found in a head-down position, etc.

Laboratory tests are frequently helpful in corroborating the proper diagnosis here but should not be the sole evidence upon which the diagnosis of drowning is founded.[5]

II. Chemical Asphyxia (not included in this discussion)

A. Cyanide poisoning

Cytochrome oxidase inhibition

B. Carbon monoxide poisoning

C. Carbon dioxide poisoning

[5] C.E. Wiggins and J.L. Luke, The Pathology, Diagnosis and Medical-Legal Aspects of Death by Drowning, J. Oklahoma Med. Assn., 63: 3-7, 1970.

James L. Luke, M.D.
Chief Medical Examiner
District of Columbia

NOTES

NOTES

* * * * *

# Fire and Heat-Related Deaths

* * * * *

**BASIC DEATH INVESTIGATION**

**CJ 401**

# FIRE AND HEAT-RELATED DEATHS

Instructor:

Arthur E. Westveer
FBI Academy
Quantico, Virginia

# FIRE DEATHS

1. Bodies Recovered from Fire

2. Manner of Death

    a. Homicide
    b. Suicide
    c. Natural
    d. Accidental
    e. Undetermined

3. The Investigation

    a. Scene
    b. History
    c. Autopsy
    d. Toxicology

4. Fire Investigations Require Team Effort

    a. Fire Investigation    Fire-Police or Both
    b. Death Investigator    Police
    c. Forensic Pathologist
    d. Toxicologist
    e. Radiologist
    f. Odontologist
    g. Anthropologist

5. Questions to be Answered:

    a. Are the remains human?
    b. Who is the victim?
    c. What was the cause of death?
    d. What is the manner of death?
    e. Was the person alive at the time of fire?
    f. If alive, why did the victim not escape?

6. Identification

    Human or Animal

    Bones, Blood, Organs, Hair, Teeth

Complete Destruction of the Body:

The average house fire seldom reaches temperatures above 1200°F. Skin will char; soft tissue will remain because of the significant percentage of water in tissues.

Cremation:

Requires a temperature of 1800° to 2100°F.

Period of two hours or longer.

Still leaves two to four pounds of ashes, bones, and some teeth.

Exceptions:

Chemical fires
Magnesium, thermite, etc., may reach into 1000°s (F).
"Candle Effect"

Identification:

1. Weight and length unreliable
2. Sex - Internal Organs
3. Fingerprints
4. Teeth - Most reliable

Cause of Death in Fires:

Heat, Flames, Toxic Gases, Disease, Blunt Force and others.

Two out of three fatalities in fires are the result of asphyxiation caused by the replacement of life-sustaining air with toxic gasses.

Severity of Burns:

1. Intensity of Heat, Flames
2. Duration of Exposure
3. Chemical

**Classification of Burns by Depth of Tissue Destruction:**

**1st Degree**
Burned area red, swollen, and painful

**2nd Degree**
Typically sun blistering; scarring may occur

**3rd Degree**
Entire thickness of skin is destroyed; scarring is usual

**4th Degree**
Complete destruction of the skin and charring of underlying tissues

**Classification of % of Body Burns - Surface Area:**

**Rule of Nines**

| | | | | |
|---|---|---|---|---|
| 1. | Head | 9% | = | 9% |
| 2. | Each Arm | 9% | = | 18% |
| 3. | Each Leg | 18% | = | 36% |
| 4. | Chest and Abdomen | 18% | = | 18% |
| 5. | Back | 18% | = | 18% |
| | | | | 99% |

Artifacts of Fire

Contraction of Muscles
Fractures of the Large Bones
Fracture of the Skull
Splitting of the Skin

If Alive at the Time of the Fire, Why Did the Victim Not Escape?

Possible Reasons:

1. Escape Route Blocked
2. Heavy Smoke, Fumes
3. Explosion, Extreme Heat
4. Exits Locked, Barred, or Obstructed
5. Victim Unconscious?
6. Drugs/Alcohol
7. Physically Unable
8. Mental Condition
9. Restraints

Body on the Scene:

1. Photographs and Sketch
2. Examine and Move Body Carefully
3. Sift Debris Under Body for Evidence or Identification
4. Clothes, Cloths Smelling of Accelerants Should Be Collected and Placed in a Clean, Airtight Container.

Soot Deposit in Larynx and Trachea Indicates the Victim Was Alive at the Time of the Fire.

Carbon Monoxide Combines with the Hemoglobin of the Blood and Forms a Complex Called Carboxy Hemoglobin.

Carboxy Hemoglobin Restricts the Amount of Oxygen Carried by the Blood to the Tissues of the Body Resulting in Asphyxiation.

In Nearly All Fires, the Supply of Oxygen is Insufficient to Allow Complete Combustion of all Available Carbon Compounds = Resulting in the Production of Carbon Monoxide (CO).

PHYSIOLOGICAL EFFECTS OF CARBON MONOXIDE:

| | |
|---|---|
| 0 - 10% | Slight Loss of Mental Sharpness |
| 10 - 20% | Slight Headache, Dilation of Skin Vessels |
| 20 - 30% | Severe Headache, Throbbing |
| 30 - 40% | Severe Headache, Weakness, Dizziness, Confusion, Nausea, Vomiting, Collapse |
| 40 - 50% | Fainting, Rapid Heartbeat, Collapse, Death in Some Individuals |
| 50 - 60% | Fainting, Rapid Breathing, Possible Coma, Convulsions, Respiratory Irregularity |
| 60 - 70% | Convulsions, Depressed Heart Action, Death |
| 70 - 80% (and Higher) | Weak Pulse, Respiratory Failure, Death |

FACTORS TO BE CONSIDERED:

1. Rate of Inhalation of Gas
2. Requirement of Oxygen - Activity or Lack of Activity
3. Individual Variation in Susceptibility

RATE OF INHALATION:

Most Important - Death from Oxygen Starvation is not Rapid.

Persons Unconscious from Carbon Monoxide Inhalation Continue to Breathe, Thus Building a Higher Concentration of Carbon Monoxide.

EXAMPLE #1

Victim exposed to a marginally excessive quantity of Carbon Monoxide over a period of time. Blood saturation increases slowly, mixed with good air being breathed. When enough blood hemoglobin has been effected, victim will die.
The carboxy hemoglobin level will be low.

EXAMPLE #2

Victim exposed to a very high level of Carbon Monoxide. Victim breathes in excessive levels of Carbon Monoxide rapidly even after unconsciousness.
Blood level very high (70-80%).

SIGNIFICANCE

Victim with minimal % of Carbon Monoxide indicates a long exposure to relatively low concentration of gas.

Victim with high % of Carbon Monoxide indicates a much shorter exposure to a high concentration of gas.

SOURCES OF CARBON MONOXIDE

1. Defective Heating Equipment
2. Engine Exhaust
3. Industrial Processes, Unintentional or Deliberate
4. Fires Involving Structures, Clothing, or Furniture

Everyone is exposed to some degree of Carbon Monoxide.
In the Atmosphere
Urban Area High, Automotive Exhaust
Factories
Tobacco Smokers - As Much as 5%.

Hypothermia:
Core Temperature Less Than 32.2$^{o}$C.

Heat-Related Illnesses:

1. Heat Cramps
2. Heat Exhaustion
3. Hyperthermia

Heat Cramps:

Due to loss of body salt through seating.
Characterized by painful muscles.
Body temperature is normal.

Heat Exhaustion:

Due to water and salt depletion.
Characterized by progressive lassitude, vomiting, tachycardia, and hypotension.
Body temperature may be normal or slightly elevated.

Heat Stroke

A life-threatening emergency usually characterized by:

1. Severe CNS Disturbances
2. Hyperthermia (41 - 43°C)
3. Hot, Dry Skin

PREDISPOSING FACTORS

1. Common to Exercise-induced and Non-exercise-induced Heat Stroke:
   a. High temperature and humidity
   b. Drugs that increase heat production
   c. Drugs that decrease thirst and sweating

2. Non-exercise-induced Heat Stroke:
   a. Chronic illness
   b. Abnormal sweat gland function
   c. Abnormal hypothalamic function
      IMBALANCE OF BODY TEMP.

3. Exercise-induced Heat Stroke:
   a. Inadequate Acclimatization
   b. Obesity
   c. Potassium Depletion

NOTES

NOTES

* * * * *

# Firearm Injuries

* * * * *

# FIREARMS

BY: Arthur E. Westveer
Behavioral Science Services
FBI Academy
Quantico, Virginia

BLANK PAGE

## FIREARMS

Misconceptions regarding bullet wounds:

1. An entrance wound is always smaller than an exit wound.

2. An exit wound never resembles an entrance wound (shored wound).

3. Right-handed individuals commit suicide by shooting themselves in the right side of the head.

4. More than one shot indicates murder, not suicide.

## MANNER OF DEATH

Homicide, Suicide, Accidental

## FIREARM INJURIES

Direction
Distance
Damage
Device - Weapon

### POWDER

1. Flake (18-24 inches)
2. Flattened Ball (36 inches)
3. Ball (42-48 inches)

### ENTRANCE WOUNDS

1. Contact-Near Contact
    a. over firm tissue
    b. over soft tissue

2. Intermediate Range

3. Long Range or any Range Covered By Clothing

## INTERMEDIATE RANGE

Contact or Near Contact

Direction and Ranging Factors

1. Hot Gases - Charring - Singeing or Burning
2. Smoke and Lead Vapors - Soot or Smudging
3. Lead or Bullet and Barrel Lubrication
4. Powder Grains - Tattooing, Stipling or Peppering
   Unburned
   Partially Burned
   Burning
5. Bullet - Abrasion Collar or Marginal Abrasion

## EXIT WOUNDS

1. Usually Stellate
2. Slit - Fragmented
3. "Shored"

## DIRECTION FROM GRAZE WOUNDS

Abrasions
Tears

## RIFLE WOUNDS

High Velocity Comparison

| | |
|---|---|
| .38-caliber Revolver | 800-950 feet/second |
| 30-30 caliber Rifle | 2700-300 feet/second |

Beveling of Bone
Keyhole

## PATTERNS OF INTERSECTING FRACTURES

# Man leaves hospital with 6 bullets still inside head

SANTA ROSA, Calif. (AP)—A man who was shot six times in the head as he slept in his home has been released from the hospital with six .22-caliber bullets still lodged in his skull.

"He's perfectly alert, fully conscious," Dr. Stephen C. Cary said of James L. Sexton, 40. "Hasn't a single defect. It's really amazing."

"He has the entry wounds, of course, but aside from those and a stiff neck, he's all right," Cary said.

Sexton left Santa Rosa Memorial Hospital on Monday and went home. A man who responded to a knock on Sexton's door refused to answer questions.

"We aren't supposed to talk to anyone," he said, slamming the door.

Sexton was shot six times late Saturday, authorities said. His former roommate, Daniel Frost, 32, was shot and wounded by a sheriff's sergeant after a lenghty pursuit. He is listed in stable condition at Palm Drive Hospital in Sebastopol.

Police say they wanted to question Frost in the shooting. No charges have been filed, and authorities are unsure of a motive.

"We just don't know," Petalumas police Sgt. Dave Dohn said, noting that the extent of Frost's injuries have prevented questioning. "They told us he is in and out of consciousness and not able to be interviewed."

Sexton was initially listed in critical condition, but X-rays showed that none of the six bullets penetrated the brain. None was life-threatening or even disabling, Cary said.

"They're all still there, all in the right side that was exposed as he slept," he said.

One of the slugs is lodged behind Sexton's right eye but it hadn't affected his vision; two are behind the tongue and esophagus but don't impair his swallowing ability or speech, Cary said. Others are near important arteries or the spine but none requires excision.

The only bullet visible is on the back of Sexton's neck. It might be removed later for cosmetic purposes or police ballistics tests, Cary said, but there are no plans to remove the other slugs.

"It's a common misunderstanding that bullets should be removed," Cary said, "but that's not true if they're doing no harm. It seems unlikely these would affect any critical areas."

Sexton asked whether the bullets would cause lead poisoning, Cary said.

"The lead in this case is almost chemically inert," the doctor said. "He may have a problem going through the metal detectors at the airport in the future, though."

11-18-87

## FIREARM PROJECTILE REVIEW FOR MEDICAL EXAMINERS*

### Introduction

In 1986, 856 deaths in Virginia were firearm related.[1] There is a wide variety of projectiles used in contemporary firearm-related deaths, and in order to correctly interpret wounds and evidence at the scene, medical examiners need to be familiar with these projectiles.

### Historical Consideration

Early firearms used large bullets at low velocity. As component technologies improved, smaller projectiles were launched at ever increasing velocities. Kinetic energy is proportional to the square of velocity, therefore a fast light bullet can deliver the same or greater energy than a large slow moving bullet. The ultimate end point of this technological evolution would be a light or laser weapon that has only energy and no mass.

With the higher velocities came additional problems. Soft malleable lead bullets would become hot enough to smear lead on the barrel surfaces and accuracy, therefore, was diminished. These soft lead bullets also became unsuitable when rammed down the bore with a rod in black powder firearms. A solution for moderate velocities (under 1200 feet per second) was to harden the lead bullet with other metals such as antimony and tin. Greater velocities (greater than 1200 feet per second) necessitated a covering of harder metals such as copper or aluminum which are plated or wrapped around the lead core. These projectiles are referred to as "jacketed".

### Bullet Design

Velocity is a major consideration in the effectiveness of a projectile. Various modifications of the round lead ball have been developed. The basic bullet is cylindrical in shape with a round nose (Fig. 1-E). The round nose is more "aerodynamic" and eases the insertion of the bullet into the chamber of the firearm.

A depression in the nose of the bullet is formed to aid expansion, presumably increase the size of the wound track, and help retain the bullet in the target where it can expend all of its energy. This type of bullet is referred to as a hollow point (Fig. 1-D,H). At moderate or lower velocities, the purported benefits usually are minimal.

Full metal jacket (Fig. 1-C) and semi-jacket soft point bullets (Fig. 1-B) are most often associated with semi-automatic pistols.

---

* Prepared by Gregory P. Wanger, M.D., Assistant Chief Medical Examiner, Office of the Chief Medical Examiner; and John G. Ward Sr., Forensic Scientist, Division of Consolidated Laboratory Services, Bureau of Forensic Science, Commonwealth of Virginia, Norfolk.

David K. Wiecking, M.D., LL.B., Editor

dico-Legal Bulletin, Richmond, Virginia, March-April, 1987

Their presence at a death scene should alert one to look for an ejected cartridge case. If the bullet's lead core and jacket separate, recovery of the jacket is essential. (Fig. 2) The identifying unique striations used for comparison are present only on the bullet jacket.

A common target bullet, the "wadcutter" bullet, is illustrated in Fig. 1-G. Although the blunt end does not look very aerodynamic, the broad areas in contact with the barrel rifling seem to impart good stability and fine accuracy. A more aerodynamic-looking modification of the wadcutter is commonly called the semi-wadcutter (Fig. 1-H,I). The semi-wadcutter greatly facilitates the chambering of the cartridge, and it may or may not be jacketed.

Estimation of the caliber of a bullet at the scene is often helpful. A millimeter ruler can be useful in giving an early estimate. Figure 3 gives a rough estimate of the caliber based on the millimeter measurement. The diameter at the base of the projectile is the best place to measure, if it is intact. Bullets that are not intact can be identified in the laboratory by weighing and other analyses.

## New Design and Recent Developments

Some unusual modifications of bullets recently have been introduced in commercial ammunition.

One such modification is the Sabot (Fig. 1-J,K). The Sabot or "shoe" is a plastic device which holds a bullet of smaller caliber, thus enabling, for example, a .22 caliber bullet to be fired from a .30 caliber firearm. Because the smaller bullet is often lighter, much higher velocities can be reached. The Sabot separates from the bullet shortly after leaving the barrel. Since the characteristics of the bore are imparted on the Sabot, a "pristine" bullet without rifling penetrates the target. Obviously, recovering the Sabot is essential for identification of the firearm.

Rifle Sabots have been available for several years. Most recently developed is a Sabot which enables a .357 projectile to be fired in a .44 caliber weapon.[2] Preliminary work has shown that sufficient individual striations are imparted on this type of Sabot as to allow identification of a suspected fiream.[3]

Another recent development is the prefragmented bullet which is marketed as "Glaser Safety Bullet".[4] (Fig. 4) This bullet consists of a copper cup containing small lead pellets. The cup ruptures on contact, sending pellets into the tissues. It is designed to prevent over-penetration and an exiting bullet. The high cost of this ammunition makes it uncommon.

There has been recent development in shotgun ammunition as well. Shotgun ammunition in the past commonly has carried only one size of shot per shotshell. Now ammunition containing two different sizes of shot in the same shotshell is available.[5] (Fig. 5) The pathologist must now be aware that one shotgun blast can deliver two sizes of pellets.

## Conclusion

A basic knowledge of ammunition design is necessary for the proper recovery of firearms evidence and interpretation of wounds. Early estimates as to the caliber and the type of projectiles can greatly aid in the investigation.

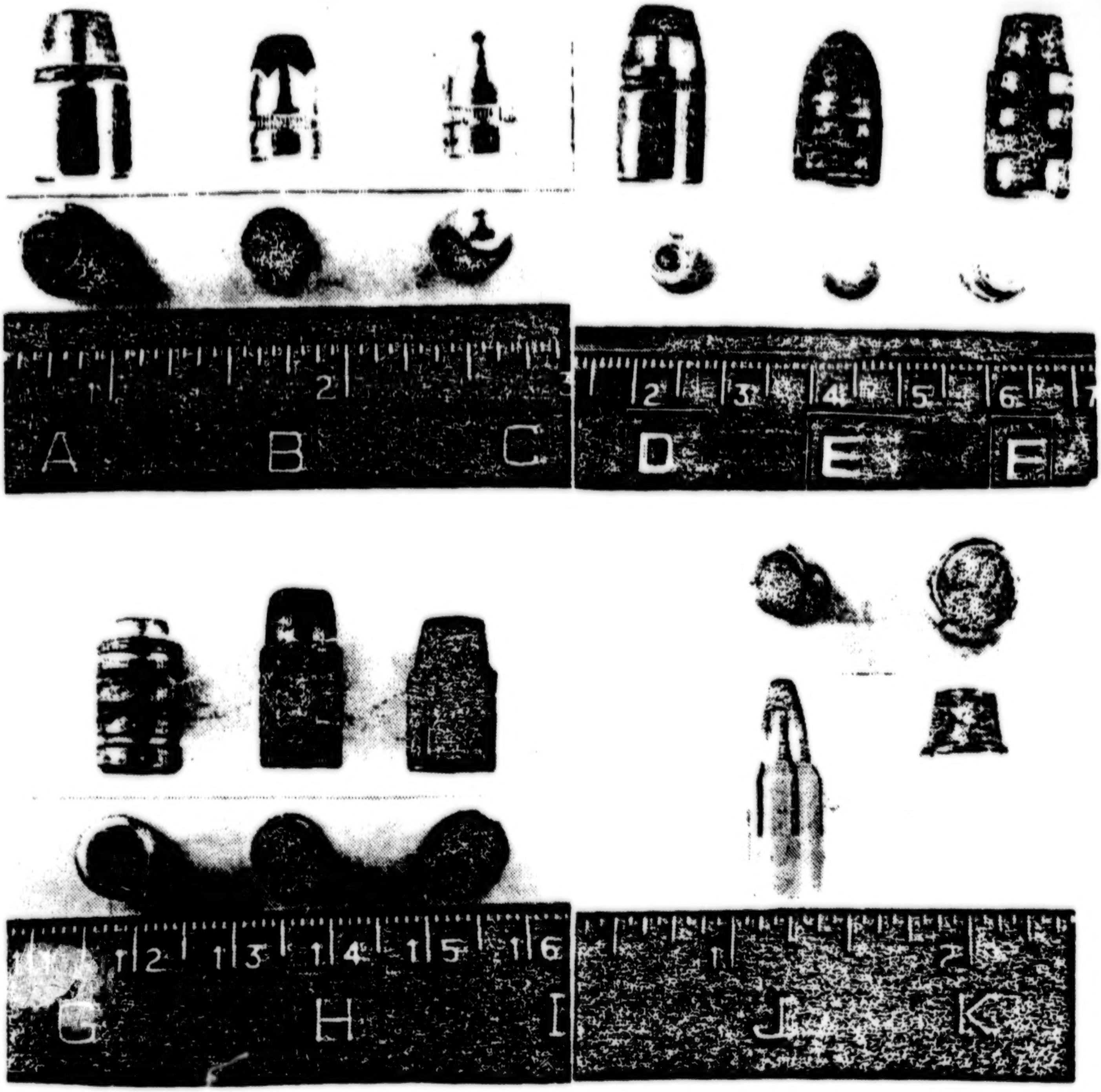



**FIGURE 1.** A - Semi-jacketed semi-wadcutter. B - Semi-jacketed soft point. C - full jacket. D - Semi-jacketed hollow point. E - Roundnose plain lead bullet. F - Semi-wadcutter. G - Wadcutter. H - Hollowpoint semi-wadcutter. I - Nylon jacketed semi-wadcutter. J - Rifle Sabot (.22 caliber bullet, .30 caliber Sabot). K - Pistol Sabot (.357 caliber bullet, .44 caliber Sabot).

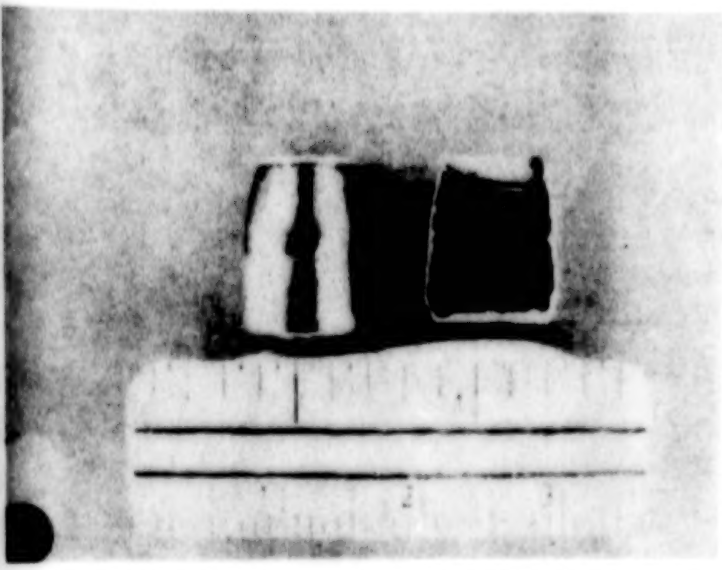
**FIGURE 2.** A .357 magnum bullet core and jacket separation in a lower abdominal gunshot wound (homicide).

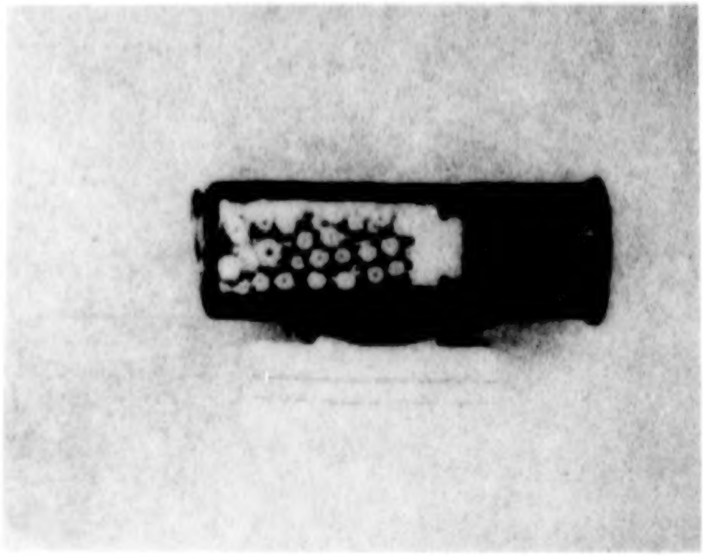
**FIGURE 3**

ESTIMATES OF CALIBER BY MILLIMETER RULER

| | | |
|---|---|---|
| 5.56 mm | - | .22 caliber |
| 6 mm | - | .243, .244 caliber |
| 7 mm | - | .278, .280 caliber |
| 7.62 mm | - | .30 caliber |
| 8 mm | - | .32 caliber |
| 9 mm | - | .355 (.357 = ".38 caliber") |
| 10 mm | - | .40 caliber |
| 11 mm | - | .44 caliber (actually .429) |
| 11.5 mm | - | .45 caliber |

**FIGURE 4.** (Left) Glazer Safety Slug (prefragmented round). **FIGURE 5.** (Right) Remington Duplex load with two different sizes of pellets.





**FOOTNOTES**

1. Medical Examiner Division Statistical Data, 1986.

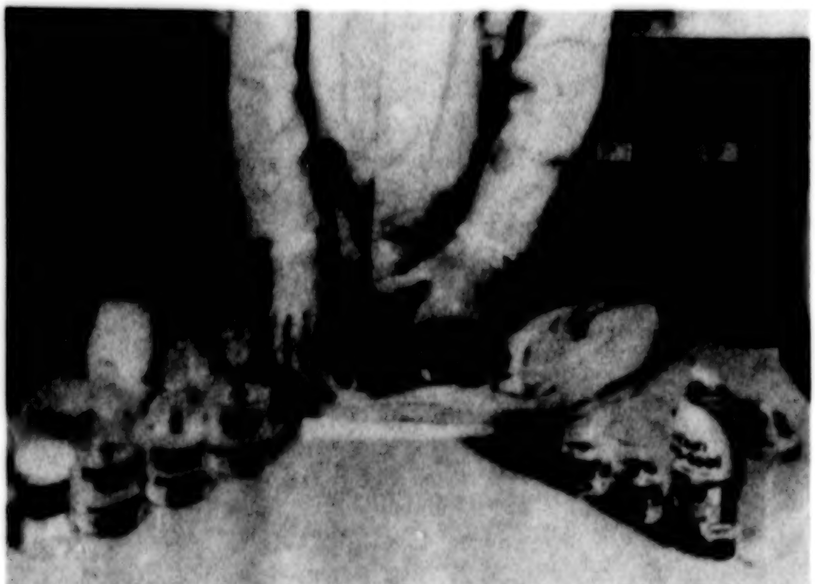
2. R. R. Sabot Inc., Payne Road, Danbury, CT. 06310

3. Unpublished data, Virginia Bureau of Forensic Science, Firearms Section, Courtesy John Ward, Sr., and Ann Jones.

4. Glaser Safety Slug, Inc., P.O. Box 8223, Foster City, CA. 94404.

5. "SPBBX4, SP2X6" Remington Arms Co., Barnum Avenue, Bridgeport, CT. 06601.

# GUNSHOT RESIDUES AND SHOT PATTERN TESTS



Chemicals and materials necessary for conducting a gunpowder residue test.

### *Introduction*

It is not uncommon for law enforcement officers to encounter firearms or the use of firearms in criminal investigations. In fact, in 1968 over 65 percent of the criminal homicides in our country resulted from the use of a firearm.[1]

Among other things, investigators often need to know the distance a firearm was held from the victim at the time it was discharged. Likewise, they may want to determine whether a person recently fired a weapon. This type of infomation can make it possible for investigators to distinguish between murder and suicide. In some cases, it can also refute a suspect's allegation that the shooting was in self-defense. Further, this infomation might help to prove the innocence of some who have no connection with the crime in question. In this article the current procedures conducted on evidence received by the FBI Laboratory in connection with gunpowder residue, lead residue, primer residue, and shot pattems will be reviewed.

### *Evidence for Examination and Proper Handling*

Before discussing the aforementioned procedures, the necessary evidence for submission and its proper handling should be set forth.

It is of prime importance that all of the clothing through which the bullets or shot pellets have passed be submitted to the Laboratory. If a bullet hole is near the edge of a garment, the adjacent piece of clothing should also be submitted.

It is imperative in making tests for gunpowder pattems and shot pattems that the same type of ammunition as that used in the shooting be used in the tests. Ammunition

[1] FBI Uniform Crime Reports – 1968, p.7.

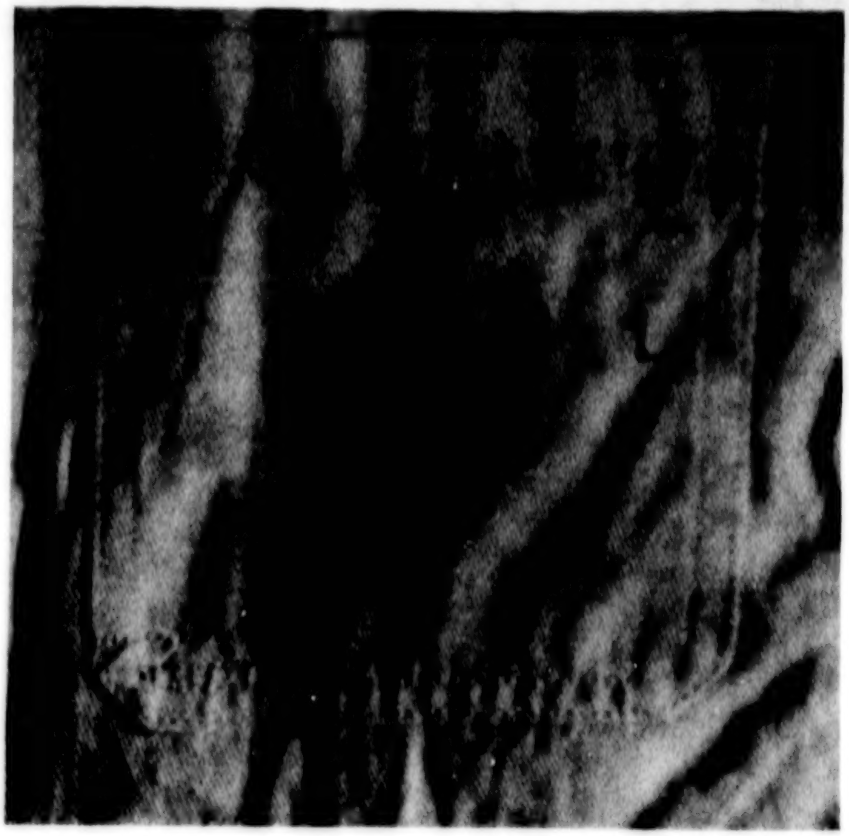
(Published by the Federal Bureau of Investigation, U.S. Department of Justice)
Reprinted from the FBI Law Enforcement Bulletin, September, 1970
(Revised February, 1979)

manufactured by different companies can produce different patterns at a set distance due to gunpowder variances such as the use of "ball" or "flake" gunpowder, as well as manufacturing differences, such as variations in shotshell wadding. Therefore, the fatal bullet and, if available, the cartridge case or shotshell casing should be submitted to the Laboratory.

The suspect weapon must also be made available to the FBI Laboratory for an accurate comparative test since the length of the gun barrel has an effect on the size of of the pattern. For example, a 2-inch barrel will deposit residue over a larger area than will a weapon having a 6-inch barrel using the same type ammunition at the same distance. Further, less complete burning in a 2-inch barrel results in more unburned gunpowder on the garment. If the suspect weapon is not available, a test can still be made of the same type of weapon if an accurate description of this weapon is furnished and if one is available in the Laboratory's reference collection of firearms. It is pointed out that the use of a duplicate weapon should be avoided, if possible, as some courts will exclude testimony unless the actual weapon is used under conditions similar to those at the time of the shooting.

The victim's clothing should be cautiously removed and carefully handled to prevent any loose gunpowder residue from being dislodged. Each garment submitted should be separately wrapped to prevent possible contamination.

Clothing containing any wet blood should be thoroughly air dried before it is wrapped. This will prevent any putrefaction, mildew or sticking together, which can leave the clothing unsuitable for testing.



Typical contact shot exhibiting characteristic smoke ring and tearing of cloth.

Examiner conducting sodium rhodizonate test.

A letter of transmittal should be prepared containing all the information as to the existing circumstances and conditions known to the investigators so that the examiner can, as closely as possible, duplicate these conditions.

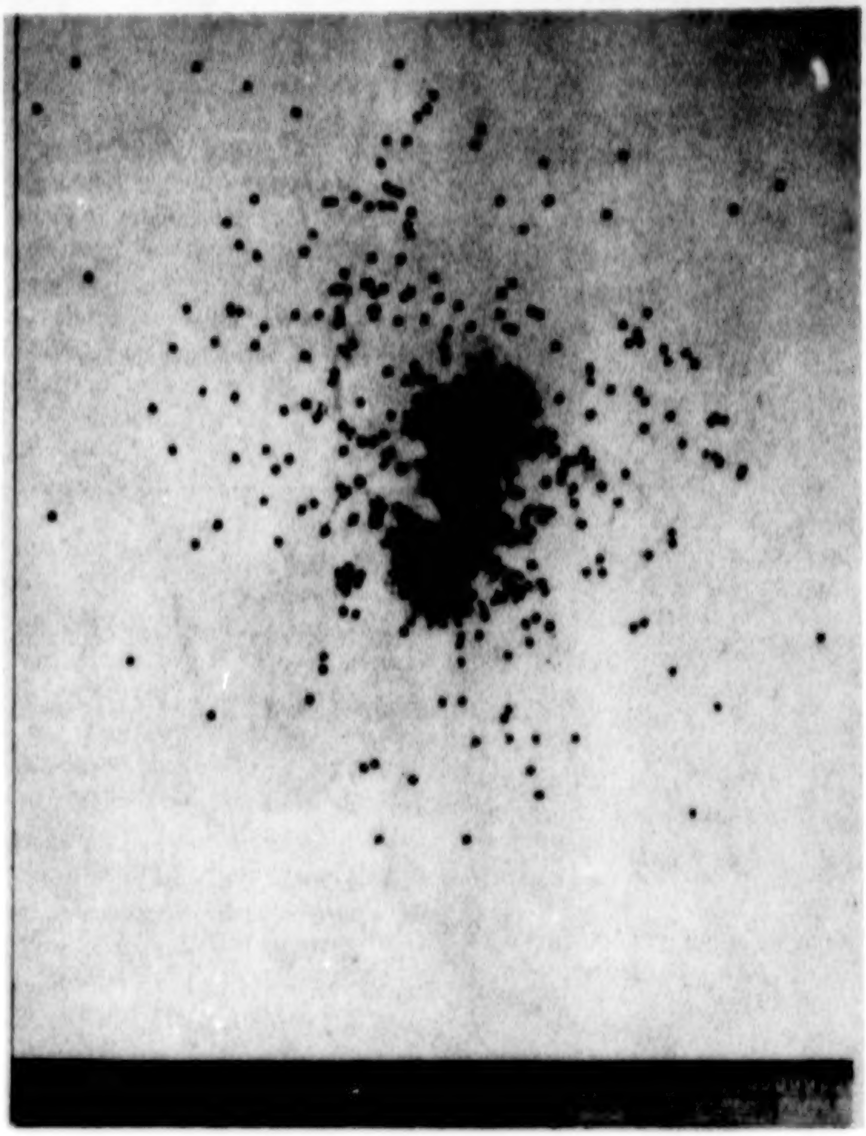
### *Gunpowder Residue*

The size and density of a pattern of gunpowder residue found on a garment are the principal factors used in ascertaining the distance between the muzzle of the weapon and the victim at the time of the firing.

As the distance between the muzzle and the victim increases, the size of the pattern increases and the density of the pattern decreases. Also, a point is reached at which no residue will be deposited. The pattern of residue found on the victim's clothing, which is comparable to the pattern produced by the suspect weapon using ammunition similar to that used by the suspect, indicates the approximate muzzle-to-garment distance. The presence of unburned gunpowder and particles of lubrication from the barrel or the bullet around the hole in the garment can also aid in this determination.

If no gunpowder residue is found around a bullet hole, it would be logical to assume that the muzzle-to-garment distance was beyond the maximum distance (for a particular weapon) that such residue would normally be deposited. However, profuse bleeding, rough handling in removing the victim's clothing, or the intervention of an object between the muzzle of the weapon and the victim may affect the amount and density of the residue found on a garment.

Conversely, no residue in a small area around the entrance hole is usually found when the muzzle of the weapon is held in tight contact or near contact with the garment. However, singeing and tearing usually accompany such shots, A melting of the ends of some synthetic fibers is sometimes noted. Unburned gunpowder and gunpowder residue are often carried with the expanding gases through the outer garment to inner garments or even directly into the wound itself.



Test pattern from 7 yards. Note pattern approximately 7 inches in diameter.

It has also been found that the passage of time can affect the density of the pattern of the residue which is chemically developed, although the size of the pattern remains approximately the same.

Therefore, it is necessary, as previously mentioned, to have all of the garments promptly submitted to the FBI Laboratory so that a complete test and proper evaluation can be made of the results.

## *Microscopic Examination*

Garments are first examined microscopically for visible indication as to the distance from which the shot was fired.

Such things as tearing, singeing or melting of the fabric, dark deposits surrounding the hole (smoke and lubrication), unburned or burned gunpowder in the fabric, and metal particles are factors which are used in the determination of muzzle-to-garment distances.

The absence of visual indications does not preclude the possibility that gunpowder residue is present. The color or fabric of the garment can prevent its visual detection. Further, gunpowder residue can be so microscopic in character as not to be detected visually.

## *Griess Test for Gunpowder Residue*

Smokeless gunpowder consists of nitrocellulose obtained from cotton or wood fibers which have been treated with a mixture of concentrated nitric and sulfuric acid. Smokeless gunpowder is, therefore, rich in what is chemically referred to as "nitrates." When smokeless gunpowder burns or partially burns, as when a cartridge is fired, the residues will contain what is chemically referred to as "nitrites."

The Griess test is used for detecting "nitrites" in the burned gunpowder residue, but it is not used for the detection of "nitrates" in unburned gunpowder.

The chemical reactions which take place in the test for nitrites are based on the conversion of the nitrites to a dye. Photographic paper which has been desensitized by photographic hypo (removing the silver halides from the paper leaving only a gelatin-coated paper) is treated with a mixture of 0.5 percent solution of sulfanilic acid in distilled water and a 0.5 percent solution of Marshall's Reagent N- (1-naphthyl) -ethylenediamine dihydrochloride in methyl alcohol. The sheet of paper is then dipped into the combined mixture and allowed to dry. The entrance hole in the garment is placed directly over and next to the gelatin side of the treated photographic paper. The nitrites from the burned or partially burned gunpowder particles present on the garment are transferred to the desensitized and treated photographic paper by pressing the garment with a hot iron using a pressing cloth dampened in a 15 percent solution of acetic acid in distilled water. The sulfanilic acid is diazotized by nitrous acid, formed by the breakdown of the nitrite by the acetic acid. This diazo compound couples with Marshall's Reagent to form an orange-red azo dye. This reaction will not occur unless nitrites are present and the reaction must occur in the presence of an acid.

The burned or partially burned gunpowder particles present originally on the garment will have been transferred to the paper in the form of orange-red dye specks. The pattern of the dye specks on the paper will be the same as the pattern of burned or partially burned gunpowder particles on the garment before it was tested.

The size and density of the pattern are the bases for determining the distance between muzzle and victim at the time of discharge.

## *Sodium Rhodizonate Test for Lead*

When a cartridge is fired, minute lead particulate and primer residues can be deposited around a bullet hole in a definite pattern. These patterns are produced by the turbulence of the expanding gases which deposit the minute lead particulate on the garment. The source of the lead particulate can be from the surface of a lead bullet, the core of jacketed bullet, or lead compounds in the priming mixture.

The sodium rhodizonate test is used to detect the lead which is usually deposited in the form of smoke or invisible residue around a bullet hole. This test is a valuable adjunct to the Griess Test inasmuch as it ensures one of getting a more definite picture of exactly what has been deposited by the weapon on a garment or other inanimate object. It is pointed out that the Griess Test is always performed prior to the sodium rhodizonate test.

The colors developed in this test are entirely dependent upon the metals present and the degree of acidity. Lead is the only metal normally found in cartridges which will react positively with this test. A saturated solution of sodium rhodizonate in distilled water is first sprayed on the area around an entrance hole in a garment or inanimate object. A buffer solution consisting of 1.9 grams of sodium bitartrate and 1.5 grams of tartaric acid in 100 ml of distilled water (ph 2.8) is sprayed on next. The pink color formed is the reaction product of sodium rhodizonate and

lead in contact with a controlled acid strength (ph 2.8). We make the test specific for lead by changing the acid concentration by spraying with an hydrocholoric acid (HCl) solution of 5 ml of concentrated HCl in 95 ml of distilled water. The HCl spray changes the color of the product of the reaction of sodium rhodizonate and lead from pink to blue. While this latter reaction is not clearly understood by chemists, a plausible explanation is that the increased acidity causes the formation of a colored blue complex product consisting of lead rhodizonate and hydrochloric acid, which is a chromophoric ("color producing") material.

The size and shape of the pattern are the bases for determining the muzzle-to-garment distance.

### *Approximation of Muzzle-to-Garment Distance*

After the garment or garments have been microscopically examined and chemically processed, test shots are fired at various distances from muzzle-to-test cloth, ranging from contact to that distance at which no residue will reach the cloth. The cloth at each distance is chemically processed and the pattern obtained is compared for size and density with the pattern obtained from the victim's clothing. The distance at which the test pattern most closely resembles the the pattern obtained from the victim's garment in size and density is the approximate distance from which the shot was fired.

### *Shot Pattern Tests*

Theoretically, the shot discharged from the average cylinder bore sporting shotgun will cluster together and not separate to any apprecible extent until the cluster has traveled approximately 3 or 4 feet from the muzzle of the weapon. The shot begins to spread, covering a larger area, as the distance between the muzzle and target increases. The degree of spread is approximately proportional to the range, but not exactly so, due to the many variables involved. These include variations from shell to shell in loading, gunpowder, gunpowder loads, wadding, loading pressures, shot sizes, and the varying deformation of shot as it travels through the barrel.

Weapons themselves present variables which affect accurate reproduction of shot patterns, such as barrel length, muzzle constriction (choke), and the condition of the gun barrel.

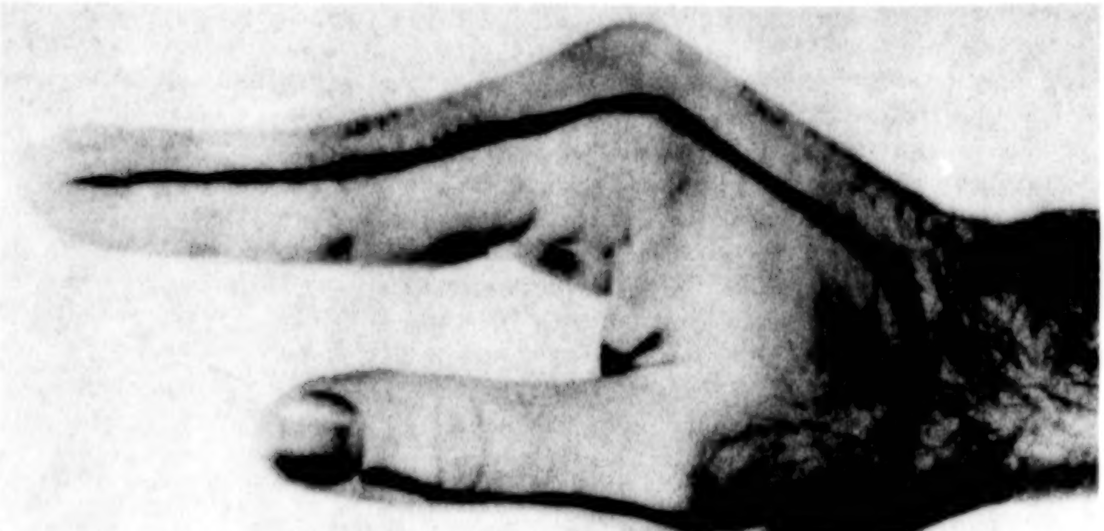
The results of tests conducted in the FBI Laboratory are based on a number of shots which are fired from the suspected shotgun utilizing the same type of ammunition as that used in the crime. The average spread of each pattern is recorded after firing at varying distances from the target. The distance at which a shot pattern comparable to that on the victim's garment is obtained is reported as the approximate distance from which the fatal or questioned shot was fired.

As an investigative aid, the muzzle-to-victim distance can be estimated. Generally speaking, an inch of spread in the pattern is equal to 1 yard. Thus, a 5-inch pattern would be produced at approximately 5 yards.

### *Examination for Primer Residue*

The problem of determining if a suspect has fired a weapon often arises during the investigation of a murder or apparent suicide. The diphenylamine test on paraffin lifts from the hands has been found to be extremely unreliable for determining whether a person actually has fired a weapon. The reagents used in this test, diphenylamine or diphenylbenzidine, are not specific for the detection of gunpowder residue since they will also react positively with other oxidizing agents. It is to be noted that oxidizing agents that will react positively to the afore-

**Area of hand sampled in chemical test for primer residue.**



mentioned reagents are also present in such common substances as soil, fertilizer, tobacco, cosmetics, and many others, as well as gunpowder residue. Therefore, the FBI Laboratory does not use this test as a method for determining if a person has fired a weapon.

A residue test without the ambiguities of the diphenylamine test, yet amenable to a modern crime laboratory, involves the use of neutron activation analysis. The elements antimony and barium, which are found in most primer mixtures for ammunition, have been found to deposit on the back of the hand of a shooter as the firearm is discharged.

Generally, when a firing pin strikes the primer, the primer mixture explodes and ignites the smokeless powder charge in the cartridge. The escaping gases can deposit antimony and barium from the primer mixture on the shooting hand in amounts normally so small that their presence cannot be detected by ordinary techniques. Employing neutron activation analysis or atomic absorption, one can positively identify these elements and measure their concentrations.

The investigator removes the residue from the hands of a suspected shooter by swabbing the back of the thumb, forefinger, and connecting web area of each hand with two cotton applicator-type swabs moistened with 5 percent nitric acid. The swabs from the right hand must be kept separate from those from the left hand. If an investigator spends 60 to 90 seconds swabbing the pertinent portion of each hand, he will have obtained as much residue as needed. This time includes moistening the swabs and placing them in the container. The investigator must exercise care to insure that he does not contaminate the swabs by touching them with his hands or placing them on a possibly contaminated surface.

Swabs from the back of the right and left hands along with two moistened unused swabs as a blank, packaged separately, should be submitted to the FBI Laboratory. The letter of transmittal must include information concerning the caliber and type of firearm, brand of ammunition involved, and the amount of time between the suspected discharge of the firearm and the swabbing of the hands. Of course, this information is in addition to the brief description of the facts of the case.

The decision whether or not to obtain swabs from a suspect must be made by the investigator who has the facts surrounding the case at his disposal. For investigative information, it has been shown that the antimony and barium deposits can be removed from the hand by washing, rubbing, and wiping. Obviously, if many hours or a few days elapse between the time of the shooting and the obtaining of the swabs, the chance that the antimony and barium deposits remain is certainly minimized. However, in a suspected suicide case, many days may pass without the body being disturbed, in which case time is not a factor. Additionally, it has been demonstrated that the position of the weapon in the shooter's hand (for instance, held by both hands or held upside down) will affect the deposition of gunshot residue.

If significant amounts of antimony and barium are detected on the swabs from one or both of the hands, of a person, it is desirable to test fire the firearm in the FBI Laboratory to determine if, in fact, the firearm does deposit antimony and barium on the hand.

The Laboratory report submitted to the contributing agency will state that the amounts of antimony and barium detected on the swabs from one or both of the hands are consistent with the amounts detected on the hand or hands of a person who has discharged a firearm or has been in close proximity to a discharging firearm. This latter clause is normally necessary because tests have demonstrated that antimony and barium can be deposited on the pertinent portions of the hand of a person who is merely standing close to the person who actually discharges the firearm.

If no significant amounts of antimony and barium are detected, it will be pointed out that this does not preclude the possibility that the person discharged a firearm. The absence of significant amounts of antimony and barium should not imply that a person has not discharged a firearm.

## *Testimony of the Examiner*

The examiner who conducted the gunpowder pattern tests, shot pattern tests, or neutron activation analysis can testify at court proceedings as to his results. However, he can testify only to the approximate distance that a comparable gunpowder pattern as that found on the victim's clothing was obtained or the approximate distance from which a comparable shot pattern had been produced.

In the event no gunpowder residue was found as a result of his microscopic examination and chemical processing of the victim's clothing, his testimony is limited to this finding and that it is not possible to determine the approximate muzzle-to-garment distance. The examiner will point out, however, the maximum distance at which residue will be deposited by the particular weapon.

### *Examination of Body Tissue*

The FBI Laboratory receives many requests to examine body tissues for the detemination of muzzle-to-victim distance. The examination of body tissue is strictly the job of the medically trained coroner or pathologist. The FBI Laboratory does not conduct such examinations.

BLANK

## GUNSHOT AUTOPSY

1. WERE INJURIES PRODUCED BY BULLETS?

2. DID DEATH RESULT FROM GUNSHOT INJURIES?

3. WAS VICTIM DEAD BEFORE SHOT WAS FIRED? IF SO, WHAT IS CAUSE OF DEATH?

4. OTHER INJURIES NOT BY GUNSHOT? WHAT TYPE WEAPON?

5. IF MULTIPLE WOUNDS, PRODUCED BY ONE BULLET?

6. RECOGNITION OF ENTRANCE AND EXIT WOUNDS

7. DISTANCE BETWEEN MUZZLE OF WEAPON AND VICTIM

8. DIRECTION OF FIRE - CORRELATED BY FINDINGS AT SCENE AND TRACK OF MISSLE WITHIN THE BODY

9. LOCATION OF BULLET, PELLETS OR SHOTGUN WADDING BY MEANS OF X-RAY OR FLUOROSCOPY

10. TYPE OF WEAPON (REVOLVER, AUTOMATIC, SHOTGUN, ETC.)

11. CHARACTERISTICS OF WEAPON

12. PROPER RECOVERY OF MISSILE (NO MARRING BY METAL INSTRUMENT)

13. EXAMINATION OF CLOTHING FOR POWDER OR OTHER RESIDUES, MATCHING WOUNDS WITH HOLES, ETC.

14. EXAMINATION OF HANDS OF VICTIM FOR SOILING, BURNS OR OTHER INJURIES

15. KNOWLEDGE OF SCENE AND CIRCUMSTANCES OF CASE

## COMMON ERRORS OF OBSERVATION AND INTERPRETATION IN GUNSHOT CASES

1. FAILURE TO PERFORM A COMPLETE AUTOPSY

2. NONRECOGNITION OF GUNSHOT WOUNDS IN OBSCURE OR UNEXPECTED LOCATIONS (MOUTH, EYE, VAGINA, AXILLA) AND IN BURNED OR DECOMPOSED BODIES

3. FAILURE TO UTILIZE X-RAY OR FLUOROSCOPY FOR LOCATION OF BONE INJURIES OR MISSILES

4. MISINTERPRETATION OF LACERATED (EXPLOSIVE) CONTACT WOUNDS AS EXIT WOUNDS (OR BLUNT FORCE INJURIES)

5. FAILURE TO EXAMINE BULLETS FOR EVIDENCE OF RICOCHET

6. MISINTERPRETATION OF GREASE AND OTHER BULLET FOULING AS POWDER RESIDUE

7. INCORRECT IDENTIFICATION OF THE LARGER OF PAIRED WOUNDS AS THE EXIT WOUND MERELY BECAUSE OF ITS SIZE

8. INCORRECT IDENTIFICATION OF THE EXIT WOUND HAVING MARGINAL ABRASION, CAUSED BY PRESSURE ON SKIN UPON EXIT OF MISSILE, AS A WOUND OF ENTRANCE.

9. PREMATURE RELEASE OF INFORMATION BEFORE CORRELATING ALL INVESTIGATIVE, AUTOPSY AND LABORATORY FINDINGS

NOTES

NOTES

* * * * *

# Substance Abuse Deaths

* * * * *

# SUBSTANCE ABUSE DEATHS

BY
Arthur E. Westveer
Behavioral Science Services
FBI Academy
Quantico, Virginia

# SUBSTANCE ABUSE DEATHS

## Manner of Death

Accident
Homicide
Natural
Suicide
Undetermined
Unclassified

Pathologist
Complete Autopsy
Proper Specimens
Interpretation

## Toxicology and Drug Deaths

Toxicology
The study of poisons, their actions, and analysis

Interpretation
Must be in the light of all available data

## Drugs of Abuse

Narcotics
Depressants
Stimulants
Hallucinogens

## Narcotic Deaths

1. Acute or sudden
2. Delayed - natural

## Sudden Death

1. Respiratory depression
2. Anaphylactic reactions

## Narcotics

Morphine
Heroin
Demerol
Codeine
Dilaudid
Darvon
Talwin

Diacetyl Morphine (Heroin)
Plus

Lactose
Quinine
Procaine
Mannitol
Talcum

## Scene Investigation

Medical History
Position
Last Seen Alive
Medications
Pill Containers
Notes - Prior Threats

## Specimens

Collect in Every Case
Blood
Urine
Liver
Bile
Stomach Contents

Delayed Complications of Narcotic Abuse

## Medical Complications of Narcotic Abuse

1. A.I.D.S.
2. Hepatitis
3. Tetanus
4. Heart Infections
5. Malaria
6. Syphilis
7. Gangrene

## Depressants

1. Barbiturates
2. Ethyl Alcohol
3. Tranquilizers
   Librium, Vallium
4. Other Sedatives
   Quaalude, Placidyl

## Death from Depressants

1. Respiratory Depression
2. Synergistic Drugs
3. During Withdrawal

## Types of Barbiturates

Fast-acting: Secobarbitol (Reds)
Intermediate: Amytal
Combination: Secobarbitol and Amytal
Tuinal
Long-acting: Phenobarbital

Sedative Withdrawal

1. 12-16 Hours: Improvement, Alertness
2. 16-24 Hours: Shakes, Tremors, Insomnia
3. 24-72 Hours: Delirium, Convulsions, Death

## Stimulants

Amphetamines
Cocaine
Caffeine
Strychnine

## Stimulant Overdose

1. Mania and Aggression
2. High Fever, Convulsions
3. Unconsciousness, Death

## Hallucination

A perception that no stimulus exists.
Tactile, Visual, Auditory

## Mental Effects

Confusion of Senses
Conflicting Emotions
Separation of Body and Self

## Hallucinogens

1. Lysergic Acid Diethylamide - LSD
2. Phencyclidine - PCP
3. Tetrahydrocannabinol - marijuana
4. Mescaline - MDA
5. Glue and Solvent Sniffing
6. Over-the-counter Drugs

## Dangers of Hallucinogens

Panic
Paranoia
Flashbacks
Accidental Death

Aerosol and Solvent Sniffing

**Anti-Depressants**

| | |
|---|---|
| **Tricyclics** | **Elavil** |
| **Amitriptyline** | **Tofranil** |
| **Imipramine** | **Sinequan** |
| **Doxepan** | **Loxitane** |
| **Loxapine** | |

**Tricyclics**

**Psychiatric History**
**Pill Containers**
**Prior Attempt**
**Depression**

**Tricyclic Intoxication**

Coma
Pyrexia
Seizures
Arhythmias
Respiratory Depression

**Phencyclidine Abuse**

Smoking
Snorting
Ingestion
Intravenous
Cutaneous

**Effects (PCP)**

Body Image Changes
Disorganized Thought
Estrangement
Hostility
Apathy
Negativism

Duration of Effect

| | |
|---|---|
| Early | 2-5 minutes |
| Plateau | 15-30 minutes |
| Loaded | 4-6 hours |
| Normal | 24-48 hours |

PCP Death

1. Intoxication
2. Behavioral
   Accident
   Homicide
   Suicide

## NOTES

* * * * *

# Autoerotic Fatalities

* * * * *

# BASIC DEATH INVESTIGATION

CJ 401

# AUTOEROTIC FATALITIES

Instructor:

Arthur E. Westveer
FBI Academy
Quantico, Virginia

# AUTOEROTIC FATALITIES

Auto = Self                Erotic = Arousal

## "SEX WITHOUT A PARTNER"

Not new
1000 A.D. Mayan culture
Not limited to American culture

## Non-Dangerous Autoerotic Activity

| | |
|---|---|
| Masterbation | Voyeurism |
| Pornography | Fantasy |
| Cross Dressing | Props |

## Mechanism of Death

Carotid Artery
Oxygenated blood to brain
6.6 pounds of pressure to restrict the flow of blood
Jugular vein
4.4 pounds of pressure required

A. Ligature around neck, pressure applied
B. Euphoric state, aroused state of sexuality
C. Impaired judgment
D. Loss of consciousness

## Typical Scene

A. Private or secluded area
   Does not want anyone to know
   Does not want to be interrupted
B. Typical hanging
   Non-total suspension
   Wide variety of ligatures
C. Suspension point within reach
D. Attire
   1/3 in costume
   1/3 nude
   1/3 normal dress
E. Erotica
   Anything which sexually stimulates an individual
   Expected vs. unexpected
   Is there an abnormal amount?
   Does it belong there?
   Cost
F. Bondage
   Variety of positions
   Unnecessary bindings
   Neatness
   Restriction of the senses
G. Mirrors
H. Padding

Evidence of Prior Activity

1. Marks on suspension points
2. Complexity of Mechanisms
3. Quality and quantity of props
4. Bondage sophistication
5. Recordings (photos, tapes, diaries)
6. Prior victim trauma
7. Confirmation by family or friends

Factors to Consider

1. Injurious agent
   Any method or device used to restrict the amount of oxygen to the brain, reducing the level of consciousness.
2. Escape mechanism
   Any method or device used to reduce or remove the effects of the injurious agent
3. Victim judgment
   Most common reason for death

Who are the victims
Victim profile based on research

| | | |
|---|---|---|
| A. | White male | 139 |
| | Black male | 4 |
| | White female | 4 |
| | Black female | 3 |
| B. | Age | |
| | 26.5 average | |
| | 77 years oldest | |
| | 9 years youngest | |
| C. | All but one middle class | |
| D. | No known history of sexual or mental disorder | |
| E. | 11 homosexuals (documented) | |
| F. | All in good spirits | |
| G. | Above average in intelligence | |

Cause of Death

Asphyxial deaths (132)

| | | |
|---|---|---|
| A. | Neck compression | 118 |
| | 1. Hanging | 105 |
| | 2. Strangulation | 13 |
| B. | Obstruction of airway | 2 |
| | 1. Smothering | 1 |
| | 2. Chocking | 1 |
| C. | Chest compression | 2 |
| D. | Exclusion of oxygen | 10 |
| | 1. Plastic bag | 5 |
| | 2. Gas inhalation | 5 |
| E. | Abdominal ligature | 2 |

| | |
|---|---|
| Non-asphyxial deaths | 18 |
| A. Electrocution | 6 |
| B. Natural (heart attacks) | 4 |
| C. Miscellaneous | 8 |

<u>How They Learn</u>

1. Word of mouth
2. Literature
3. Experiments
4. Accidents

<u>Questions Most Frequently Asked</u>

1. Was there anything I could have done?
2. Was it my fault?
3. Was he/she mentally ill?

<u>Important That You Are Able to Recognize And Discuss Professionally With</u>:

1. Public
2. Family
3. Insurance Company
4. Others

<u>Medicolegal Problems</u>

Lack of knowledge
Misdiagnosed as suicide, homicide
Altered crime scene
False/misleading information

# OVERVIEW OF AUTOEROTIC ACTIVITY

By:

Kenneth V. Lanning
Behavioral Science Unit
FBI Academy

## Why Autoerotic?

Autoerotic may be defined as sexual feelings or sexual gratification which are self-induced without having sexual relations with another. It might be asked why someone would choose to have sex without a partner. There are of course many possible reasons, some more obvious than others.

One of the more obvious reasons is simply that no sex partner is available when the sexual gratification is needed or wanted. This unavailability may be due to some special circumstances such as separation from a spouse or confinement in an institution. It may also be due to time restraints or limitations which prevent the seeking out or meeting with a sex partner.

Another reason for choosing to have sex without a partner might be because there is no preference for or desire to have sex with another. This lack of preference for a partner may be due to a variety of personal inadequacies or insecurities. It may also stem from a need to be in total control during sexual activity. This need for control may result in the autoerotic practitioner assuming the dual role of both participants in some sexual fantasy. In other situations, another person may be present during the sex act, but because of these personal inadequacies or needs for total control, this person is used more like a prop than a true sex partner.

In other situations, autoerotic activity may be chosen because of shame or embarassment over the nature of sexual desires or fantasies. A spouse or lover may be embarassed to admit that he or she is interested in bondage or sado-masochistic sex acts. Rather than communicate these desires to a partner and risk rejection, alienation or ridicule, the person may incorporate these interests into autoerotic activity. In the previously mentioned dual role situation, the autoerotic practitioner could assume the role of both the giver and receiver of the pain and suffering associated with such activity.

Another possible reason may stem from moral or religious beliefs. Sex with a partner other than a spouse may be viewed as sinful. Therefore, when that spouse is unavailable for or is uninterested in interpersonal sexual activity, autoerotic activity may be viewed as a more acceptable alternative than adultery. Sexual desires repressed as immoral or sinful may be expressed in rationalized autoerotic activity.

Possibly the most common reason for selecting autoerotic activity, particularly for adolescents, is experimentation. The young teenager attempting to learn about developing sexual desires and body functioning is a likely candidate to explore autoerotic activity.

In the adolescent it is perhaps easier to see the combinations and complexities of motivation which drive any of us to engage in any form of sexual behavior. The adolescent

may be experimenting in autoerotic activity because no sex partner is available. This lack of a sex partner may be due in part to personal inadequacies, insecurities, shame, embarassment, or moral beliefs. Therefore it is possible that anyone's motivations for autoerotic sex may include part of one, one, more than one, or all of the above mentioned reasons as well as any number of additional individual variations of them.

## Variations of Autoerotic Activity

After the choice to engage in autoerotic activity is made, a wide variety of activity is possible, some considered normal some abnormal.

Probably the most widely practiced and best known form of autoerotic activity is simple masturbation. In its broadest definition, masturbation may be considered synonymous with autoerotic activity. However, a more narrow definition describes masturbation as obtaining sexual satisfaction from manual or mechanical stimulation of the genitals. No effort will be made to discuss whether masturbation is normal or abnormal. Suffice it to say, it is believed to be practiced to some degree by the vast majority of men and women, although some still consider it to be an offense against nature or the law of God. Other common forms of autoerotic activity include viewing pornography or erotic literature and sexual daydreaming or fantasy.

Other types of activity may or may not be considered to be autoerotic depending on definition of terms and opinions

concerning the nature of the acts. An individual using an inflatible doll or mannequin (pygmalionism) as a sex partner is in essence an autoerotic practitioner. A solitary voyeur prowling the back alleys at night for sexual stimulation is engaged in essentially autoerotic activity. Even the exhibitionist who uses his victims more like props than partners might be considered an autoerotic practitioner. Depending on how you define "sexual relation with another," the individual engaged in sexual relations with an animal (bestiality) or with a dead body (necrophilia) might also be considered an autoerotic practitioner. It is obvious that deeper and more complex motivations, other than merely the previously mentioned motivations for autoerotic activity, are involved in these more "unusual" forms of autoerotic sexual behavior.

Law enforcement interest in the above autoerotic activities is generally dependent on whether the acts involved are violations of the law. However, other autoerotic activities become of interest to law enforcement merely because of their nature. These activities are referred to as dangerous autoerotic practices. Such practices are considered dangerous when there is the possibility of serious bodily injury or death.

Why would someone choose to engage in an autoerotic act which is dangerous? Again there are many possible reasons. One such reason might be the need for risk taking. The prevention of a basic drive such as breathing sometimes causes excitement. Another possible reason might be the need for

pain or humiliation. The introduction of pain to sexual activity brings with it a certain potential for injury or death. A third possible reason might be a need for experimentation. Continually trying something new and different may result in finding something new and dangerous. A fourth possible reason might involve the use of hypoxia to enhance sexual pleasure. For some, the interference with the body's uptake and utilization of oxygen becomes a desired or necessary part of sexual activity in spite of or maybe because of the danger involved. A final reason for engaging in dangerous autoerotic acts might be that the participant is unaware of the danger. The danger or risk may not be desired, wanted, or understood. In one case, a young man died of exposure and exsanguination when he was accidently trapped naked in the bottom of an outhouse latrine while engaged in autoerotic activities involving coprolagnia. He did not anticipate that the rope he apparently had used many times before to pull himself up would fray and break. In some parts of the country, sadomasochists and bondage practitioners are being instructed on "safe" ways to engage in their potentially dangerous sex practices.

## Autoerotic Fatalities

Almost any activity of man has certain possible risks. And so it is always possible that someone engaged in even so called non-dangerous autoerotic practices may meet with

unexpected injury or even death. The risk of such injury or death is even greater when dangerous autoerotic practices are involved. The greatest concern of law enforcement is of course in those cases where the autoerotic activity results in death. The recognition and investigation of autoerotic fatalities may not be one of the major problems confronting modern law enforcement. However, it is an area where a small amount of training and knowledge can go a long way towards proper identification of a crime scene and the saving of investigative man hours. Although the number of such cases investigated by the police may be relatively small, any situation involving the suspicious death of a human being must be considered a serious matter.

Although the manner of death during autoerotic activity is usually accidental, it can be natural, suicide or even homicide.

An individual engaged in either non-dangerous or dangerous autoerotic practices may die of natural causes such as a heart attack. The autoerotic activity may or may not have been a contributing factor. In any case, the evidence of autoerotic activity (bondage, erotica, fetishism, etc.) might be confusing or misleading to the police investigator in such a case.

It is also possible that a person engaged in autoerotic acitivity may decide at some point to commit suicide. This point of decision might be <u>prior</u> to engaging in the activity but with the person then deliberately deciding to incorporate

their autoerotic activity into their suicide or vice versa. This point of decision might also be during the autoerotic activity. In either case, because autoerotic fatalities are typically accidental deaths, determining the manner of death would be extremely difficult. Hopefully, in most cases there will be some behavioral indicators prior to the act that such a suicide was intended. In other cases, a friend or relative may alter the appearance of a true accidental autoerotic death scene to make it look like a suicide.

An individual engaged in autoerotic activity may also become the victim of a homicide. The autoerotic activity may have nothing to do with the homicide. The victim for example, may just be coincidently found engaged in autoerotic activity when the killer strikes. The autoerotic activity may also have some bearing on the homicide. In one case, for example, a wife shot and killed her husband in his bed believing he was in fact her husband's female lover. What she did not know at the time of the shooting was that her husband was a transvestite and had fallen asleep dressed in his female clothing after engaging in autoerotic activity. In other cases, homicide crime scenes may be deliberately staged to appear to be accidental autoerotic deaths. Various items (mirrors, bondage, escape mechanism, etc.) indicating autoerotic sexual activity might be planted at the crime scene to mislead the police investigator.

## Typical Autoerotic Fatalities

The manner of death in most autoerotic fatalities is accidental. This is particularly true in dangerous autoerotic practices. Because of the inherent risks in such practices, a variety of things can and do go wrong which can result in the death of the participant.

The most common form of dangerous autoerotic activity involves the use of some method of asphyxia to achieve a state of euphoria during the sexual activity. Any of the four following methods of asphyxia can and have been selected by the autoerotic practitioner: (1) Neck compression (includes hanging and strangulation); (2) airway obstruction (includes suffocation and choking); (3) chest compression; and (4) oxygen exclusion. If any of these four methods of asphyxia are not terminated in time by the autoerotic practitioner, death will result. Therefore, the most common cause of death in autoerotic fatalities is asphyxiation.

It is important to note the distinction between sexual asphyxia and asphxial death. One refers to the use of the effects of asphyxia to heighten sexual arousal and the other refers to the cause of death. Although not necessarily always fatal, the practice of sexual asphyxia is clearly a dangerous autoerotic activity. The autoerotic practitioner who dies while engaged in sexual asphyxia, typically dies from accidental asphyxiation when for various reasons he is unable to terminate his means of sexual asphyxia. However, it is possible that

someone engaged in sexual asphyxia might die a non-asphyxial death (heart attack, exsanguination, etc.) during this activity. Conversely, it is also possible that someone engaged in non-asphyxial autoerotic activity, might die an asphyxial death (compression of chest, hyperventilation, etc.).

## Atypical Autoerotic Fatalities

As just mentioned, there are other forms of dangerous autoerotic activity which do not involve the use of sexual asphyxia. These activities can involve a wide variety of potentially dangerous practices such as the use of bondage, infibulation with objects and electricity, and life threatening games. Although it cannot be said with certainty whether these non-asphyxial dangerous practices are more widely practiced than sexual asphyxia, they do appear to be less likely to result in death. Because deaths from such activities are less common, they are referred to as atypical autoerotic fatalities.

These non-asphyxial dangerous practices can result in a wide variety of causes of death as illustrated by the following examples:

> A bondage practitioner dies of exposure when he was unable to remove his bindings and is forced to remain semi-nude in a cold, remote area.
>
> A man dies of electrocution when the wires he was using to induce electrical current into his genitals become short circuited.

A man dies of peritonitis when he failed to seek medical attention after inserting and losing a large soda bottle up his rectum.

A man bleeds to death when he failed to seek medical attention after accidentally stabbing himself while using a knife for autoerotic stimulation.

A man dies of a gunshot wound after he "lost" a game of Russian roulette he was playing with a partially loaded revolver during autoerotic activity.

## Equivocal Deaths

The typical autoerotic fatality is an accidental death caused by some form of asphyxiation. However, as this overview of autoerotic activity has illustrated, such fatalities can and do involve any of the four manners of death and any number of varied causes of death.

Of greatest concern to the police investigator is usually whether the death is natural, accidental, suicide, or homicide. Some cases are relatively easy to investigate. All the pieces are there and they all fit together. Many others are not so clear cut.

In the investigation of an equivocal death the police investigator has two major areas to evaluate: the crime scene and the victim's history.

In order to evaluate the scene of a possible autoerotic fatality, the police investigator should have some knowledge of sexually associated factors such as sadism, masochism,

bondage, fetishism, transvestism, ritualism, and fantasy. In addition, the investigator should know what a typical autoerotic death scene looks like including methods of escape and evidence of prior activity. The investigator should also be aware of the typical victim profile.

In evaluating any crime, the assistance of a good, qualified forensic scientist can be invaluable. This is especially true when evaluating a questionable autoerotic death or one involving an altered or staged crime scene. A forensic scientist who can recognize and evaluate forensic considerations such as petechial hemmorhages, pulmonary edema, hyoid bone fracture, bloody mucous from head orifices, ligature mark locations, absent or inconsistent lividity, and seminal discharges can make the differences in the proper determination of the manner of death.

The evaluation of the victim's history and background is the other critical area in the investigation of an autoerotic fatality. A good psychological autopsy to determine the victim's state of mind and behavior prior to the incident may be the best way to determine if a death was suicide or accidental. The background investigation should include interviews of friends, relatives, co-workers, etc., to determine these things as well as to determine any indications of prior autoerotic activity. Any diaries, writings, or recordings should be examined and evaluated whenever possible. Any area to which the victim had access or expectation of

privacy should be searched in accordance with appropriate legal considerations in an effort to establish victim's state of mind and sexual interests and/or to uncover evidence of prior autoerotic activity.

Journal of Police Science and Administration

Volume 9, No. 4
Printed in U.S.A.

# The Investigation of Autoerotic Fatalities

Robert R. Hazelwood, Park Elliott Dietz, and Ann Wolbert Burgess

---

Robert R. Hazelwood is a supervisory special agent and member of the faculty at the FBI Academy, Behavioral Science Unit, Quantico, VA 22135. Special Agent Hazelwood has a B.S. in sociology from Sam Houston State University, Huntsville, Texas; an M.S. from Nova University, Fort Lauderdale, Florida; and was a fellow in forensic medicine at the Armed Forces Institute of Pathology, Washington, DC. His principle fields of interest are abnormal psychology and deviant sexual behavior. Mr. Hazelwood has published in the area of deviant sexual behavior in Great Britain, Australia, Canada, and the United States.

Park Elliott Dietz is assistant professor of psychiatry, Harvard Medical School, McLean Hospital, Belmont, MA 02178. He is a forensic psychiatrist. Dr. Dietz has a B.A. from Cornell University, an M.D. from Johns Hopkins University School of Medicine, and an M.P.H. from Johns Hopkins University School of Hygiene and Public Health. His principle fields of interest are criminal behavior and the epidemiology of injuries. Dr. Dietz has published widely on the subjects of sexual deviations and offenses and injury control.

Ann Wolbert Burgess is professor and director of research at Boston University School of Nursing, Boston, MA 02215. She is the immediate past chairperson for the Advisory Committee to the National Rape Center. Her principle fields of interest are victimology, rape, and sexual assault. Dr. Burgess has a B.A. from Boston University, an M.A. from the University of Maryland, and a Ph.D. from Boston University. Dr. Burgess has coauthored many articles and books in the field of rape and sexual assault.

---

Autoerotic fatalities are deaths occurring during masturbation. Although individuals occasionally die of natural causes while manually masturbating, the focus of this article is upon deaths occurring in the course of autoerotic activities in which the decedent used a potentially injurious agent. The circumstances and features of such deaths are not commonly known and, as a result, are too often misinterpreted. The majority of autoerotic fatalities involving injurious agents are accidental, but their features sometimes lead to mistaken impressions of suicide or homicide. The fact that many autoerotic fatalities share common characteristics with suicide, such as a finding that the victim was alone in a locked room or a finding that he died by hanging, has led many investigators to initially classify an autoerotic death as a suicide. Other features, such as a blindfold, a gag, or physical restraints, have led to mistaken suspicions of homicide.

This article is based upon an ongoing study of autoerotic fatalities reported to the Behavioral Science Unit of the FBI Academy. Although we recognize that our cases are not necessarily a representative sample of all autoerotic fatalities, we believe that the law enforcement community may benefit from the unique opportunity we have had to review in detail over 125 cases. In this article we review the most important features of the autoerotic death scene and the principle sources of information regarding the victim's previous experience with the activity that led to his death.

## THE AUTOEROTIC DEATH SCENE

The autoerotic death scene and its contents will vary according to the victim's age, resources, and sexual interests. Not all of the features presented below will be found in every case, but they are suggested to the investigator as details to be observed and, if present, documented.

Although we stress scene preservation at several points in this article, we wish to emphasize that in some circumstances the investigator's first duty would be to attempt resuscitation. More frequently, however, the victim will have been dead for hours before being discovered, and that discovery will have been made by someone other than the investigator.

### Location

As in many suicides, this victim also typically selects a secluded or isolated location in which to act out his sexual fantasies. The locations involved in the population studied included locked rooms; isolated areas of the victim's residence such as attics, basements, garages, or workshops; motel rooms; places of employment during nonbusiness hours; summer residences; and wooded areas. The victim's desire for privacy is paramount in the selection of location. Such acts require concentration on the fantasy scenario and, depending on the use of props, may require considerable preparation time. Thus, the practitioner takes precautions to avoid disruption. The investigator should be alert to the possibility that the location itself may play a role in the fantasy of the victim.

*Case 1*

The victim, a 28-year-old telephone company employee was discovered dead by co-workers after he had failed to return to work from repair service calls. His repair truck was located on a rural road approximately two miles from his last service call. The body was located in a heavily wooded area 250 feet from the roadway. The victim was lying face down with the upper portion of his body resting on his forearms. Around his neck was a 3/8-inch hemp rope secured by a slip knot. The rope extended from his neck to a tree limb approximately 6 feet overhead. To the left front of the victim were four magazines depicting nude females. The victim's pants were undone and his underwear had been moved down sufficiently to expose the penis and scrotum. Medical authorities recorded the cause of death as asphyxiation due to constricted carotid arteries.

### Victim Position

Most commonly, the victim's body is partially supported by the ground, floor, or other surface. Occasionally, the victim is totally suspended. The most common position noted in our series was one in which the deceased was suspended upright with only the feet touching the surface. In most such cases, some type of ligature was around the neck and affixed to a suspension point within reach of the victim. The investigator would do well not to be unduly influenced in his opinion of whether a death is accidental or homicidal simply because the body position seemingly indicates the involvement of a second party. Accidental death victims have been found sitting, kneeling, lying face upward or downward, and suspended by their hands.

### The Injurious Agent

The investigator at any death scene is charged with the responsibility of gathering information that will allow determination of any action or lack thereof that contributed to the victim's death. We recommend that the injurious agent be studied in great detail, including a careful search for and analysis of possible malfunctioning. In our series, the most common injurious agent was a ligature of some sort that compressed the neck. Other injurious agents identified in this study included devices for passing electrical current through the body; restrictive containers; obstruction of the breathing passages with gags; and the inhalation of toxic gases or chemicals through masks, hoses, and plastic bags.

In the construction or use of these devices, the practitioner risks miscalculation. Depending upon the mechanism used, he may misjudge the amount of time, substance, pressure, or current. Whatever agent or apparatus has been used demands scrutiny by the investigator to deter-

mine whether or not a malfunction has occurred.

*Case 2*

The victim, a 19-year-old oriental male, was discovered dead in his room by friends. The young man was in a supine position with his left shoulder and upper left arm touching a metal steam radiator. He was clad in an undershirt, cutoff shorts, and socks, and was partially resting on a folded quilt, a pillow, and canvas material. An electric floor buffer rested between his legs. The buffer's electrical plug was originally of the three-pronged variety, but the "ground" prong had been removed. The buffer's switch was held in the "on" position by a piece of electrical wire. The victim's body had extensive burns on the inner thighs and left shoulder. Investigation determined that the buffer was slowly turning between his thighs when the victim was originally discovered. A subsequent examination of the buffer revealed that it was electrically deficient, causing current to pass from the buffer through the victim's thighs and exiting his left shoulder upon contact with the metal radiator.

**The Self-Rescue Mechanism**

The self-rescue mechanism is any provision that the victim has made to reduce or remove the effects of the injurious agent. The self-rescue mechanism may be nothing more than the victim's ability to stand erect, thereby lessening the pressure about his neck, or it may be as involved as an interconnection between ligatures on the extremities and a ligature around the neck, thereby allowing the victim to control pressure on his neck by moving his body in a particular way or pulling on a key point. Any of a wide variety of items or potential actions that the practitioner had available may have been intended as a self-rescue mechanism. If the injurious agent is a ligature, then a slip knot or knife may be involved; if locks are involved, then a key should be sought; if chains are involved, a pair of pliers may be nearby. As with the injurious agent itself, the possibility of a malfunction of the self-rescue mechanism must be carefully considered. The following case illustrates the necessity for identifying and closely examining the self-rescue mechanism:

*Case 3*

A 23-year-old white female was found to have died as a result of neck compression during dangerous autoerotic activity. The woman had used an extension cord to interconnect her ankles with her neck. She had used a slip knot as a self-rescue mechanism. Examination of the slip knot revealed that in tying it, the victim had inadvertently allowed her hair to become entangled in the knot, thereby preventing her from disengaging it.

**Bondage**

The phrase "bondage and domination" is used to describe a range of sexual behaviors closely related to the features commonly associated with autoerotic deaths. Bondage refers to the use of physically restraining materials or devices that have sexual significance for the user. The importance of this characteristic cannot be overemphasized, for its involvement is most often responsible for the misinterpretation of these deaths as homicidal rather than accidental. It is perfectly understandable that this factor can create problems for the individuals responsible for determining the manner of death. In those cases in which the authors have been called upon to provide an opinion as to whether a death was autoerotic or not, it was usually the involvement of bondage that created a question as to whether the victim alone was responsible. Each case must be judged on its own merit, as there is no hard or fast rule to follow.

Physical restraints noted in this study included ropes, chains, handcuffs, and other similar devices that restricted movement of the victim and/or his limbs. Even in obvious cases, it is incumbent upon the investigator to prove that it was physically possible for the victim to have placed the physical restraints as they were discovered. It may be necessary to duplicate bindings or knots, and for that reason, the knots should not be cut or undone prior to scrutiny. Failure to be thorough in this aspect of the case may create additional problems in dealing with the family of the deceased. Even when the investigation is particularly thorough and well documented (as described in case 4),

the involvement of bondage may preclude familial satisfaction with the death being ruled accidental and sexually related:

*Case 4*

The victim, an 18-year-old white male, was discovered dead in the garage of his residence. He was inside a 30-pound garbage can with only with his head protruding. He was in a sitting position with his knees drawn tightly against his chest and his feet resting on the bottom of the can. His arms extended down his sides and between his calves and thighs. His wrists had been loosely bound with roller skate straps. The police used a chisel to split the can and remove the victim. A roll of chicken wire extended partially across the mouth of the can. The victim's knees and elbows were abraded, and there were scratch marks around his mouth. In his room were found numerous pieces of knotted rope and straps. Toxicologic analysis revealed no trace of drugs or alcohol, and the autopsy showed no other injuries. The death was ruled to be the result of autoeroticism. The parents refused to accept the ruling and conducted their own investigation. Eventually the matter was resolved, but it is unlikely that the victim's parents will ever believe that their son's death was sexually related.

The investigator may sometimes be faced with more subtle forms of bondage. These oblique bondage factors often are not recognized and thereby contribute to potential investigative misinterpretation. Some examples found in this study included hoods, blindfolds, gags, decorative chains, elastic, and constrictive garments, such as ace bandages. Failure to recognize such oblique bondage features has sometimes led to investigative misinterpretation.

### Masochism

The investigator will sometimes find that the decendent had inflicted pain upon his genitals, nipples, or other areas of the body. In addition to whatever pain may be associated with bondage restraints of constrictive materials, pain may have been induced mechanically, electrically, or through self-induced burns or mutilation. Cases in our series have included a belt tightened around the scrotum, clothespins affixed to the nipples, electrical wire inserted in the penis or anus, an electrified brassiere, and cigarette burns of the scrotum. The term "infibulation" is used to describe the passing of needles or pins through body, most often through the scrotum, penis, or nipples, but sometimes through an earlobe or the nose. In one case in our series, pins had been passed through each of the decedent's nipples. The self-mutilation may be more extreme as in the following case:

*Case 5*

This 31-year-old male was found suspended from a beam via a rope fashioned in a hangman's noose around his neck. His feet were touching the floor. He was nude except for a black leather belt about his waist. Handcuffs secured his wrists in front and a key to the handcuffs were found in his right hand. Examination of his penis revealed a surgical-like incision around the circumference of the shaft. Inserted and tightened into the incision was a metal washer. The outer edge of the washer was flush with the penis shaft.

### Attire

Frequently the victim is attired in one or more article of female clothing, especially undergarments. Nylon, lace, leather, rubber, or other materials that held sexual significance for the victim are commonly part of his attire. The investigator should be alert to the possibility that the victim's attire has been adjusted, altered, or completely changed by the victim's family or associates prior to the investigator's arrival. Although such an occurrence was not commonly reported to the authors, the police contributing cases reported added difficulty in resolving the manner of death when such alterations had occurred. Although the individuals responsible for altering the scene were technically interfering with a death investigation (a punishable offense), none were charged. In each instance in which the victim's attire had been altered, this had been done by family members. They attributed their alterations to shame, embarrassment, or impulse.

*Case 6*

A 16-year-old white male was found dead in his room by his father. When the police arrived, they found the victim to be lying on his back and wearing blue jeans, a T-shirt, jockey shorts, and wool socks. A belt, looped on one end, was near the victim's head, as were his glasses. The father informed the officers that when he originally found his son, he was wearing only his socks and T-shirt. The victim's underwear and pants were on the floor at the end of the bed. The father said that he had dressed his son without thinking and did not know why he had been undressed when first found.

As illustrated by the case described above, the investigator cannot assume that the scene has remained unchanged since its discovery. Had the adjustment in attire not been discovered, the death might have been ruled a suicide. Close examination of the body and its lividity may reveal that attire or restraints have been adjusted, altered, or completely changed.

**Protective Padding**

Frequently, the victim will be found with soft material between a ligature and the adjacent body surface. The purpose of this protective padding is to prevent abrasions or discoloration that might prompt inquiries from friends or family. In case 6, the parents had no idea their son was involved in such dangerous activities. The mother, however, recalled that some months prior to her son's death she had noticed "burn" marks on either side of his neck. When she inquired as to their cause, he had explained the marks as having occurred when he had been grabbed by his jersey while playing football. When he was discovered dead, there was no protective padding in evidence.

In cases involving more experienced or sophisticated victims, the probability of finding protective padding is greater than in the more youthful victim. Commercially available bondage equipment includes leather and satin-like restraints lined with lambs wool, fur, or other soft materials, and these are sometimes found in use or among the possessions of autoerotic death victims. In several cases in our series, the victims had displayed considerable ingenuity in permanently affixing protective padding to their homemade apparatus.

*Case 7*

An older, white male victim was discovered dead in his residence. He had interconnected his neck and feet with rope and belts which were arranged over a hook installed on the inner wall of his closet. The interconnecting ligature caused his body to arch. He had attached rubber foam insulation to that portion of the ligature around his neck. The rubber foam was held in place with duct tape.

**Sexual Paraphernalia**

Sexual paraphernalia were found on or near the victim in many cases in our series. These paraphernalia included vibrators, dildos, same and opposite sex photographs, sexual literature, sketches, and fetish items such as female garments, leather, and rubber items. Quite often, materials that are present are not recognized as having a sexual meaning for the victim because they do not appeal sexually to the investigator and are dismissed as inconsequential. All items at the scene and their proximity to the body should be noted and photographed in original positions for later interpretation. Failure to do so may result in valuable clues being lost. The following case involved such items and, fortunately, was well documented in writing and photographs:

*Case 8*

The victim, a 17-year-old white male, was found partially suspended by the neck (feet touching the floor) via a rope attached to a pipe positioned across an opening to his attic. The body was nude, and his hands were loosely bound behind his back. The police searched the room in which he had died and found an expensive 35mm camera containing a roll of undeveloped film. The film, developed by police, depicted the victim in several sexual poses. The police also discovered a sketch, depicting females in poses approximately the victim's position at death, and an altered photograph from a magazine. In searching the attic over the victim's room,

the police discovered the following items: six socks that had been cut, several lengths of rope with knots in them, a bicycle tube with a sock tied to it, one pair of black rubber gloves, several pieces of black bicycle innertube, one pair of blue knee pads, one pair of underwear attached to a T-shirt with silver duct tape and cut from the neck of the shirt to the crotch of the underwear, one two-by-four, and a portion of one-inch electrical conduit bent in the middle.

Much of the material documented in case 8 might have gone unnoticed by an untrained investigator, for the sexual significance of the items is not obvious. It is also noteworthy that in Case 8, as in many others in the series, the victim's erotic materials may be in locations other than the immediate scene. Materials found in other cases have included diaries, writings on bondage, escapology, and knot tying. In some instances an overwhelming number of materials are found, as in case 9, an extremely well-documented case submitted to the authors by the Royal Canadian Mounted Police:

*Case 9*

The victim, a 51-year-old single man, was discovered suspended via a rope around his neck and attached to a tree limb. His feet were touching the ground. He was attired in normal clothing except that he had on two leather jackets, one of which belonged to a teenage neighbor. The subsequent investigation revealed that he was a homosexual and had attempted to solicit sex with the neighbor boy on the day of his death and was rejected. He was able to talk the young man into leaving his leather jacket overnight.

A search of the victim's residence revealed a large amount of sex photographs, bondage, and fetish items. Included in the inventory of items were over 50 leather jackets and coats, ropes, chains, handcuffs, leg irons, a penis vise, scrotum weights, electrical shock devices, a variety of leather discipline masks and helmets, traffic cones with fecal matter on them, 107 pair of leather gloves of which 29 were determined to have seminal stains inside, a mace with chain and spiked ball, canes, whips, and assorted padlocks. The investigating officers made a videotape of the materials and graciously provided the authors with a copy.

### Masturbatory Activity

The victim may or may not have engaged in manual masturbation during the fatal autoerotic activity. The presence of seminal discharge is not a useful clue in determining whether a death is due to sexual misadventure. Seminal discharge frequently occurs at death, whether the victim died accidentally, naturally, or as the result of homicide or suicide.

The authors have repeatedly found investigative personnel who rely heavily on this single factor as evidence that an autoerotic death has occurred. To be sure, the existence of seminal stains on the victim or nearby surfaces should be noted, photographed, and collected for possible blood type determination and comparison to the victim, but the mere presence of seminal staining is not evidence of sexual activity.

Manual masturbation may be evidenced by finding the victim's hand on or near his genitals. Other indicators of sexual activity include such findings as a dildo or vibrator in or near the body, the penis wrapped in cloth to prevent staining of garments, or exposure of the genitals of a victim who is otherwise dressed. The authors have found that there is frequently no direct evidence of manual masturbation, and without such evidence the investigator would be ill-advised to make assumption. Although it is sometimes said that suicide victims avoid nudity, it is not yet known whether complete or partial nudity is sufficient to distinguish an autoerotic death from a suicide.

## EVIDENCE OF PREVIOUS EXPERIENCE

Although an important element in understanding what occurred in a particular case is knowledge of the victim's previous experience with the activity that led to his death, surprisingly few of the routine medical or police reports we have seen have addressed the issue of previous experience. We have found five types of information useful in determining the extent of the victim's prior experience.

**Information from Relatives and Associates**

Although family members, sexual partners, and friends sometimes have no awareness of the victim's dangerous autoerotic practices, they may nonetheless have observed behavior that gains meaning in retrospect. One father noted that his son was always tying knots. Another father knew that his son occasionally put a belt around his neck and tightened it until becoming weak. In another case, the parents of a 30-year-old man noted that each night before dinner he had locked himself in his room and they had heard a humming noise. He had used an electrical device as part of the autoerotic activity through which he died.

In other instances, a relative or associate may be aware of the victim's prior activities. The wife of a 26-year-old victim had discovered her husband suspended from an exercise bar on two occasions prior to the fatal episode. Another wife advised that her husband was in the habit of placing a towel around his neck, attaching it to the bedroom doorknob, and leaning away from the door while masturbating.

**Permanently Affixed Protective Padding**

As mentioned above, the investigator should note protective padding and its placement. One factor indicative of prior practice is the permanent affixing of such padding to ligatures or devices used in the activity. This suggests that the victim either had engaged in similar acts in the past or intended to do so in the future. In either case, the padding indicated the victim's intent to prevent leaving marks on his body.

**Suspension Point Abrasions**

If the victim's death involved the use of ligatures over or around suspension points, the investigator should examine those areas and others like them for abrasions or grooves caused by similar use in the past.

*Case 10*

A young white male died while suspended from a braided leather whip that went around his neck and over the top of a closet door. The whip was secured to a wheel and tire on the door. His hands were free, but his ankles were loosely bound with leather thongs. The door top revealed several grooves and abrasions from previous acts.

**Complexity of the Injurious Agent**

When the injurious agent is highly complex, it is likely that the apparatus became complex through repetitive experience and elaboration over time.

*Case 11*

The victim, a 26-year-old white male, died while suspended by leather wrist restraints from a hook in the ceiling. When found, he was wearing a discipline mask and had a bit in his mouth. A length of rope was attached to either end of the bit and ran over his shoulders, going through an eyelet at the back of a specially designed belt he was wearing. The pieces of rope then ran to eyelets on either side of the body and were connected to wooden dowels which extended the length of his legs. The ropes were attached to two plastic water bottles, one on each ankle. The bottles were filled with water and each weighed seven pounds. The victim's ankles had leather restraints about them. Affixed to each of the victim's nipples were clothespins. The victim's belt had a leather device which ran between his buttocks and was attached to the rear and front of the belt. This belt device had a dildo that was inserted in his anus, and an aperture through which his penis protruded. His penis was encased in a piece of pantyhose and a toilet paper cylinder. A small red ribbon was tied in a bow at the base of his penis.

**Collected Materials**

The type, quantity, complexity, and cost of sexual materials collected by the victim provide indirect evidence of the duration of his activities.

*Case 12*

The body of this 61-year-old white male was discovered by a family member. It was determined that the victim had died of a heart attack during autoerotic practices. The victim was lying on his bedroom floor and was attired in a black leather hood and leather ankle and wrist restraints (lined in lambs wool) that were interconnected with fine link chain. The chain was wrapped around his waist and secured with small locks. He was also wearing a snug-fitting black leather half slip, black socks, and pajama tops. Two black leather briefcases were open on one of two twin beds in the room and contained leather, locks, and chains. An electric vibrator was present on the other bed. On his dresser were several padlocks and keys. All of these items were determined to have been commercially produced and available to the general public.

While in most instances the victim will be found in close proximity to his collection of sexual materials, the investigator should search all areas known to be under control of the victim for additional materials.

## SUMMARY

The first professional investigator confronting an autoerotic fatality is usually a law enforcement officer. The investigator may find a complex, bizarre, and easily misinterpreted scene of death. This article described the features of autoerotic fatalities to enhance the investigator's ability to recognize and describe such cases, even when attempt has been made to conceal the facts of the death.

## REFERENCES

Burgess, Ann Wolbert, and Hazelwood, Robert R. 1981. *Psychiatric nursing in the hospital and the community*, 3rd ed. Englewood Cliffs: Prentice-Hall.

Burton, J. F. 1977. Adolescent sex hangings. In *Forensic pathology: A handbook for pathologists*, edited by R. S. Fisher and C. S. Petty, pp. 133-135. Washington, DC: U.S. GPO.

Edmondson, J. S. 1972. A case of sexual asphyxia without fatal termination. *Br. J. Psychiatry* 121:437-438.

Ford, R. 1957. Death by hanging of adolescent and young adult males. *J. Foren. Sci.* 2:171-176.

Hazelwood, Robert R.; Burgess, Ann Wolbert; and Groth, A. Nicholas. 1981. Death during dangerous autoerotic practice. *Br. J. Soc. Sci. and Med.* 15:129-133.

Litman, Robert E., and Swearingen, Charles. 1972. Bondage and suicide. *Arch. Gen. Psychiatry* 4:80-85.

Resnick, H. L. P. 1972. Eroticized repetitive hangings: A form of self-destructive behavior. *Am. J. Psychotherapy* 26:4-21.

Rupp, J. C. 1973. The love bug. *J. Foren. Sci.* 18:259-262.

Sass, F. A. 1975. Sexual asphyxia in the female. *J. Foren. Sci.* 20:181-185.

Spitz, W. U. 1973. Asphyxia. In *Medicolegal investigation of death*, edited by W. U. Spitz and R. S. Fisher. Springfield, IL: Charles C Thomas.

Usher, A. 1963. Accidental hanging in relation to abnormal sexual practices. *Newcastle Med. J.* 27:234-238.

Walsh, F. M.; Stahl, Charles J.; Unger, H. Thomas; Lilienstern, Oscar C.; and Stephens, Robert G., III. 1977. Autoerotic asphyxial deaths: A medicolegal analysis of forty-three cases. In *Legal medicine annual*, edited by Cyril H. Wecht, pp. 155-182. New York, NY: Appleton-Century Crofts.

# NOTES

NOTES

* * * * *

# Suicide

* * * * *

# <u>SUICIDE INVESTIGATION</u>

Winston C. Norman
Criminalist/Major Case Specialist
Behavioral Science Unit
NCAVC/VICAP
FBI Academy
Quantico, Virginia

Suicide and society's attitude toward it vary from culture to culture.

Ranks ninth among the top ten causes of death.

Average 20,000 to 35,000 successful suicides each year.

Experts think this number low; put the figure at least twice the reported number.

Not accurately identified because of:

Altered scene
Investigation
Inexperience
Outside pressure

Teen-age Suicide

Over 5,000 each year
Tripled in last 20 years

Parasuicide: attempt but intent not real

Estimate two to eight times the number of actual suicides

Suicide of the Elderly

Twice as high as teen-age suicides in those over 75 years of age.

Euthanasia: The act or practice of killing individuals that are hopelessly sick or injured for reasons of mercy

Passive Euthanasia: discontinuing life-sustaining measures

Active Euthanasia: Actually causing death

"Right to Die"

Some psychiatrists and philosophers feel that rational man should have this choice.

Right to die societies active in 18 countries.

"Hemlock" here in U.S.

"Let Me Die Before I Wake"
"How To Die With Dignity"

Publications on suicide

Necessary elements of suicide:

1. Present intent to commit suicide

2. Specific act that carries out that act

Clues to suicide

Intent and Lethality

If high in both, good indicator of suicide

Communication by decedent

Direct

Verbal, written, other

Less Direct

Psychological Autopsy: A profile of the decedent based on an in-depth examination and analysis of his thoughts, feelings and behavior

Should be used in all deaths where manner of death is questionable.

Problems in determining manner of death may be due to:

1. Investigation
2. Processing of crime scene
3. Medical examiner/coroner
4. Background information

Sources of information:

Records

Interviews

Scene

Structured Interview - Interview follows a predetermined structure. All persons interviewed should be asked the same questions.

Rapport - Important

Questions:

1. Period of association

   When met

   How often would see

   Nature of association

2. Describe victim

3. What changes did you notice?

   What

   When

   What was going on in his/her life at the time?

4. Describe physical changes:

   Frequency, Severity, Duration

   a. Physical complaints

   b. Sleep

   c. Appetite

   d. Indigestion

   e. Nausea

   f. Bowel disturbance

   g. Decreased sex drive

5. Interviewee's explanation of death

6. Who else would know something about deceased?

7. Anything else to add?

Conclusion:

   Summary of information obtained

   1. Profile of deceased

   2. Stressors identified

   3. Reaction to the stressors

Specialized Criminal Investigations

Death Investigative Techniques:

# THE PSYCHOLOGICAL AUTOPSY

Table of Contents

## I. INTRODUCTION

In the certification of death, a physician must distinguish both the cause and mode of death. While nearly 140 possible causes of death are listed in the International Causes of Death, only four modes are categorized: Natural, accident, suicide and homicide. However the mode becomes obscured when more than one can possibly explain the death (Sneidman, 1976).

Resolution of unexplained deaths has long been of concern within law enforcement and for the past quarter century an object of inquiry for the mental health field. While each of these fields focuses on the examination of death from its own perspective, their common goal suggests the importance of mutual interest and collaborative efforts.

The investigator's role in death investigation has traditionally involved the processing of crime scenes and the interviewing of witnesses. Physical evidence is of value in determining the methods of death, while interviews are of importance in providing potential motives for death. Together, physical evidence and witness statements constitute investigative procedures which usually are effective in establishing a reason for the loss of life.

In comparison to the broad and well established responsibilities of law enforcement personnel in death investigations, mental health workers have had specific, but limited involvement. For over twenty-five years psychologists and psychiatrists have studied psychological motives for death, and as a result have developed an increased understanding of life threatening behavior. In particular, stress and depression have been studied as precursors to suicide, and therefore suicide has become a better understood mode of death (Litman, Curphey, Sneidman, Farberow, and Tabachnick; 1963). Like the investigator, the mental health worker attempts to determine motives for death by use of interview techniques. Yet there are also forms of related objective evidence in the psychological investigation. For example, stressful life events and resultant behavioral and/or psychosomatic effects may contribute significantly to evidence progressive emotional deterioration, without which suicide would be unexpected, if not unexplainable.

In the following discussion the psychological autopsy is presented as a collaborative procedure in which both mental health personnel and law enforcement investigators have important roles. To clarify the psychological perspective of this technique, it will be explained in greater detail to indicate suicidal clues and to detail specific interview procedures.

## II. THE PSYCHOLOGICAL AUTOPSY

The term "Autopsy" is usually associated with the postmortem examination of human remains to determine the cause of death. The psychological autopsy is similar as it is an investigation of antecedents of death which potentially reveal the deceased's contributions to his own demise (Weisman, 1974). Yet more precisely, the Psychological Autopsy is an analytic statement prepared by a mental health professional, based upon the deceased's thoughts, feelings and behavior. Such post-dictive assessments are, of course, speculative. Yet if the reason for a death was without question, there would perhaps be no need for investigation. Rather, it was because of absences of information that the psychological autopsy was developed. Its specific purpose, therefore, is to form a logical understanding of death from tangible physical evidence, documented life events and intangible - often illusive emotional factors. To accomplish its purpose, the psychological autopsy is structured to address three questions: What was the deceased like?; what occurred in his life that could have been stressful?; and what were his reactions to those stresses? The psychological investigation of a death begins with understanding the deceased's personality characteristics. From this understanding, the individual's influence upon situations is clarified, as are the effects of those events on that individual's capacity to endure.

To gather information about a deceased person, interviews are conducted with persons who associated with the deceased, such as relatives, friends and coworkers. Because of the diversity of associations that may exist, these resources may have different perspectives of a deceased. This variety of perspectives reflects the various roles and responsibilities that characterized each association. For example, spouse, parent, serviceman and friend are simultaneously existing roles common to most adult Air Force personnel, yet each of these roles reflects unique characteristics.

It is also important to identify situations that individually or in combination, may have presented overwhelming distress. Some events are objectively stressful. For example, divorce, acute illness or death of a family member would have an intense impact for anyone. Yet other, more subtle situations may occur, which from the perspective of the deceased were equally disturbing. For example, occupational promotion, retirement or the anniversary of a prior stressful event may precipitate tension and anxiety or add to existing progressive depression. In the next section, the Psychological Autopsy will be discussed as a technique to identify indications which may be predictive of suicide.

## III. CLUES TO SUICIDE

This section will discuss the deceased's potential intent to commit suicide as interpreted from the means of death, crime scene evidence and unusual behavior.

In combination, the crime scene and method of death may offer indirect indications as to the objective of the deceased. Usually, the more precise the death plan, the more lethal the intent. For example, a self-inflicted gunshot wound in an isolated location incorporates both a potent means of injury (high lethality) and diminished potential for rescue (high intent). Conversely, crime scene evidence in cases of sexual asphyxia usually reflects attempts to increase sensuality. Here low lethality may be inferred if rescue devices are present (e.g., a knife to cut the rope used for hanging) and low intent suggested by the presence of pornographic pictures (which are used to heighten sexual stimulation) (Litman & Swearington, 1972; McDowell, 1978). In such a case death would most probably be accidental.

Combinations of high lethality and low intent may also occur. A classic example of such a combination is the lonely housewife who swallows a lethal quantity of poison just prior to the time her husband is expected to return home from work. Yet on that day, he is unexpectedly detained at the office and arrives home only to discover his wife's body.

The intent to commit self-destruction may also be evident in direct communications. Sneidman (1969) cites findings from the Los Angeles Suicide Prevention Center in which over 80% of all suicidal deaths were preceded by verbal threats of self destruction. Those clues were direct statements in which the deceased declared their intent to kill themselves. Such expressions varied, but among them were phrases such as: "I'm going to commit suicide" and "I want to die". Most of these expressions of anguish were made to people important to their lives, but often occurred in the context of anger. Because of the manipulative quality of these remarks, the threat was often ignored and only considered as a ploy to gain control. Frequently, less direct indications were also apparent. These statements suggest terminal frustration and resignation, and might include phrases such as "I can't stand it any longer," "you'd be better off without me," or "Good-bye, I won't see you any longer." But these declarations were either not recognized or were discounted because of the individual's seemingly improved situation. Actually, over half the suicides reported occurred at times when crises seemed nearly resolved. Suicide researchers now recognize that the period of improvement following a personal crisis is often the most dangerous phase of the episode.

Also common are subtle, often cryptic messages that appear indicative only in retrospect. These communications may settle personnel accounts and thereby complete responsibilities in preparation for death. Among the behaviors associated with these subtle communications are increasing life insurance coverage, giving away of prized possessions, and, under suitable pretexts, contacting family and friends one last time. Sometimes these final contacts are attempts to test relationships. The suicidal individual may ask directly for assistance or indirectly seek permission to share his torment by presenting an unconvincing denial of his difficulties.

The most well-known written clue in self-destructive deaths are "suicide notes". However, the presence of such a note does not confirm the finding of suicide. At best, any such communication may provide indications as to the pressures and conflicts which effected the deceased. These in turn should suggest additional sources to contact to provide a more complete understanding of the deceased's circumstances (Sneidman & Farberow, 1957). Attachment 1 of this paper is an example of a typical suicide note.

## IV. GATHERING INFORMATION

### The Role of the Mental Health Professional

As exemplified in the previous discussion of suicidal clues, many indications of suicidal motives are subtle, indirect and perhaps even contradictory. For this reason, and to assure that the collection and synthesis of information is credible, it is important that a mental health professional be a resource to the investigation.

The professional consultant may assist in directing, or perhaps even participating in the inquiry to better understand the deceased, his experiences and the influences on his life that may have contributed to the death. It is important to enlist the aid of this resource at the beginning of the investigation, and that the doctor's attention be drawn to whatever aspects of the case that appear contributory. Finally, the mental health professional should be asked to report his findings, which will constitute the psychological autopsy report. An example of a psychological autopsy report is appended as attachment 2 of this paper. This particular report resulted from the same case in which the exemplified suicide note (attachment 1) was found.

### Sources of information

Record reviews and interviews are among the most valuable sources of information in the psychological examination of death. Records provide a rich quantity of documentation, while interviews additionally provide a host of claritive information. Both sources are essential.

#### RECORDS

Personnel: Consolidated Base Personnel Office files disclose demographic data to include, age, education, assignment history, time on station, marital status, dependents, promotions, efficiency ratings, etc. Further, AF Form 246 may be helpful in identifying the deceased's plan to provide life insurance assistance to survivors.

Medical: Important medical entries could include past and present illnesses, medications, and duty restrictions. Mental health records are separate files which may reflect a history of psychiatric illness, to include prior suicidal episodes.

INTERVIEWS

Surprisingly, official inquiry into a death generally receives little resistance (Sneidman, 1976). Yet, individuals who are uncomfortable in talking about the deceased may minimize their descriptions of the deceased's torment preferring to "Speak well of the dead." Also, close associates and family members may be grief stricken or emotionally upset, and make interviewing quite difficult. Sometimes family reactions to the unexpected suicide include denying the possibility of self infliction, preferring to emphatically endorse notions of homicide. In each of these instances, the mental health consultant may be helpful in supporting the investigator's interview efforts.

Two interview procedures are present in most psychological investigations. First, witnesses to the death event and related incidents should be queried with regard to their observations. Individuals who had further personal knowledge of the deceased would then receive a structured interview, which is based upon procedures developed at the Los Angeles Suicide Prevention Center (Sneidman, 1976; Weisman, 1974). Other individuals to receive this structured interview could include, coworkers, supervisors, family, friends, chaplain, etc. The structured interview was developed to objectively collect information which is not routine to standard criminal investigative procedures. Detailed presentation of the structured interview procedure follows.

## Structured interview

Introduction: The psychological autopsy interview requires a high degree of rapport between the interviewer and interviewee. Rapport is so critical that extra care should be taken to put the interviewee at ease. Usually the interview is facilitated by sharing a sense of loss in discussing the death, and asking the interviewee to be candid so that the tragedy of the death might be better understood. A direct appeal for the interviewee's help often assists in clarifying the purpose of the interview, the importance of the interviewee's statements and the value of the interviewee's contribution.

1. Period of Association

   The credibility of the reference is in part established by the frequency, duration and quality of his association with the deceased: When did they first meet? How often did they associate? What was the nature of the association (e.g., coworker, friend, etc.).

2. **Description of the Deceased**

Asking an interviewee to respond to a question such as "What was (Name of the deceased) like?", may further validate the nature of their association, while providing the interviewee's opinions of the deceased. This portion of the interview may also permit the further development of rapport and emphasize the value of the interviewee's involvement in the investigation.

3. **Behavioral/Emotional Changes**

Changes in the deceased's emotionally and/or behavior are helpful in determining the deceased's reactions to his experiences. Patterns of adjustments or progressive deterioration of coping abilities may be identified. Questions which develop this information include: "What changes have you possibly noticed in the deceased's mood (behavior)?", "When did this occur?", "What was going on in his (her) life at that time?".

4. **Problems**

It is important to determine, from the perspective of the deceased, stresses that may have been influential. For example, although the interviewee may discount the importance of some events from his (her) own perspective, the deceased may have considered an event or action to have been provoking. Inquiry that may elicit these difficulties could include "What problems/difficulties/concerns did the deceased have?", "When did that start?", "How much of a problem was that for him (her)?". It is also important to ask if the interviewee was aware of potential suicidal preoccupation. Questions should cover suicidal threats that were either direct or indirect (e.g., "I'll kill myself if..." or "I can't cope anymore"). Further, more subtle indications should be inquired about, such as behavior which "Settled affairs." (e.g., giving away possessions, planning for survivors, etc.).

5. Mental Status: Somatic indications

A mental status examination is a medical technique to assess mental functioning. This technique emphasizes somatic, or physical ailments that may be suggestive of internalized stress reactions and progressive depression. Due to the specific, intimate nature of this portion of inquiry, only close associates and family are usually able to provide this particular information. <u>In each area of questioning it is important to determine when the difficulty first began, changes in its pattern, and the extent to which it was present</u>.

Sleep: Difficulty getting to sleep
Recurrent reawakenings
Early morning rising - abrupt awakening in the morning accompanied by anxiety and restlessness.

Physical Complaints: (Medically treated or not)
Examples could be low back pain, lingering physical ailments, continual muscular tension and fatigue.

Headache: Persistent - recurring

Appetite: Decreases, lack of pleasure from favorite foods, weight loss (in absence of intentional dieting)

Indigestion: Continual heartburn
Gas
Cramps
Nausea

Vomiting

Bowel Disturbances: Recurrent diarrhea or constipation

Libido: Deceased sex drive, lack of pleasure or ability in sexual performance.

6. Interviewee's Explanation of the Death

Asking the interviewee how they explain what happened often crystalizes their perception of the deceased and why he/she may have taken his/her life.

7. Additional Contacts

Asking for developed references provides the potential for information confirming the associations of other interviewees with the deceased, while possibly identifying additional persons who can provide information not previously developed.

Also ask the interviewee if there are any further comments that they might feel are important to make.

## V. CONCLUSION

For over 25 years the psychological autopsy has been effective in examining reasons for death. The findings of the psychological autopsy report represent intangible evidence which alone cannot result in a legal determination of the mode of death. It is, however, a medium by which corroborative information may be developed. The procedure requires collaborative efforts from mental health and law enforcement fields, combining the best of each of these professions' contributions to the investigation of death.

## REFERENCES


Litman, R., Curphy, T., Sneidman, E., Farberow, N. and Zabatchnick, N. Investigations of Equivocal Suicides. Journal of the American Medical Association, 1963, 184, 924-929.

Litman, R., and Swearingen, C. Bondage and Suicide. Archives of General Psychiatry, 1972, 27, 80-85.

McDowell, C. Death Investigation: Sexual Asphyxia. Forensic Science Digest-USAF Office of Special Investigations, Washington, D.C., 1978, 4, 162-169.

Sneidman, E. Suicide. In A. Freedman, H. Kaplan and B. Sadock (Eds) Comprehensive Textbook of Psychiatry-II, Baltimore: Williams and Wilkins, 1976, 1774-1785.

Sneidman, E. Suicide, Lethality and the Psychological Autopsy, Aspects of Depression, International Psychiatry Clinics, 1969, 6, 225-250.

Sneidman E. and Farberow, N. A Psychological Approach to the Study of Suicide Notes. In E. Sneidman, N. Farberow and R. Litman (Eds) The Psychology of Suicide New York: Jason Aronion Inc., 1976, 165-174.

Sneidman, E. and Farberow, N. Clues to Suicide. In E. Sneidman and N. Farberow (Eds) Clues to Suicide New York: McGraw-Hill Book Company, Inc., 1957, 3-10.

Weisman, A. The Realization of Death (A Guide for the Psychological Autopsy). New York: Jason Aronson, Inc., 1974.

Dearest Debi,

I'll always Love you. Maybe I'm a coward, but I don't think so. I couldn't bear to lose you, but everyday I feel that I am. I don't ever want to share your love with anybody, not even if it was only one night.

I see no future for myself without your love. I'm worthless anyway. All my ideals have been shot down. I'm sorry. Please remarry and give Charlie a dad. I wanted to be so bad, but the way you talk, you'll be divorcing me soon, and you'll take him from me. I'm not doing this to hurt anyone. I just can't live with myself.

Attachment 1. Example of Suicide Note

BLANK

**Psychological Inquiry: Motives Potentially Contributing to Suicide**

1. Introduction: In reviewing circumstances surrounding the death of Al C. Smith, I have endeavored to identify factors which could contribute to understanding his state of mind at the time of his death. Obviously, any such post-dictive examination is speculative. It is drawn from interviews conducted by Special Agents at Detachment 0218 and myself, of people who knew the deceased and could offer only opinions as to his motives, feelings, and reactions to events in his life. These opinions, however, constitute perhaps the only information available that may provide insights into this tragic occurrence. The following discussion is set forth as a psychological autopsy, a dissection of what Al C. Smith may have experienced during the course of events that preceded his death.

2. Review of Events: Perhaps the most logical point in time to initiate this inquiry would be the deceased's arrival to his assignment in the Summer of 1976. From that point, focus will be drawn to approximately the last six months of his life, with particular emphasis upon the day before and the morning of his death.

a. It would appear that when the deceased arrived for his new assignment as a Security Policeman, he was highly motivated and enthusiastic. Airman Michael Jones, who had known the deceased during basic training, renewed his friendship with Danny and his wife Debbie, and both couples were described as actively enjoying their lives and their careers in the Air Force. As time progressed, however, Danny seemed to be somewhat less satisfied and both he and his wife appeared to be somewhat self-indulgent. In particular, the family seemed to incur frequent financial difficulties, which in Jones' opinion, were due largely to poor budgeting, expensive telephone bills, and expenses derived from the couple's continuing use of marijuana. Danny may have also been disappointed to find out that having a child did not produce additional Air Force income, as he apparently had anticipated. Yet Danny appeared to prosper in his work. He even received considerable recognition for his accomplishments, as exemplified by his receipt of the Airman of the Month Award in his squadron.

b. In June 1977, Danny was assigned from "B" Flight to "A" Flight which permitted him to have an additional job to meet his expenses. Al C. Smith's transition to his new work shift appeared in many ways a disappointment. He seemed frustrated that his suggestions for improving the routine of work were not welcomed, as they had been in his prior assignment, and he spoke of this disappointment with several of his friends. His health also appeared to be somewhat diminished noting that during the months of April and May 1977, he had nine hospital visits for low back pain, possible mononucleosis, and flu-like symptoms. His seemingly frequent returns to the hospital continued during the summer

Attachment 2: Example of Psychological Autopsy

and his work performance also deteriorated. During the first month of his assignment to A Flight, Danny was late to work almost every other day and he was counseled for tardiness and unkempt appearance. By August 1977, he had obtained a supplemental job off base, yet this employment appeared to develop into a source of aggravation. In an act of friendship, Danny approached his employer to hire a fellow Security Policeman, who was subsequently denied employment due to alleged racial discrimination. Further, when Danny terminated this job he was accused by his employer of stealing a ventilating fan. Danny had borrowed the fan earlier that summer, but his employer initiated civil court action in what seemed to be retaliation for claims of racial prejudice levied by Danny's black coworker. These and other documented events during the last few months of Danny's life are presented in the attached time line (attached).

c. The Smiths continued experiencing financial difficulties. Danny and Debbie appeared particularly frustrated that they were without a stove in their home and had only a hot plate on which to cook their meals. Their trailer was also without heat, and they reportedly used a local YMCA for bathing.

d. On 16 October, Danny was seen at the medical center emergency room due to a variety of symptoms which were diagnosed as a stress reaction. Yet when his family practice physician followed upon that diagnosis, Danny discounted his difficulties, stated that his situation had improved, and denied that he was stressed. Still, Danny made repeated visits to the hospital on 7, 11, 14, 15 and 17 November. He appeared to present a number of symptoms to include headache, nausea, and vomiting. In the opinion of this doctor, these symptoms appeared flu-like in nature, but in retrospect may have masked a psychosomatic reaction to stress. On 18 November, the civil suit regarding the supposed theft of the ventilating fan was concluded with a finding of not guilty. Danny was known to have enjoyed Thanksgiving with friends on 24 November and although not mentioned by individuals interviewed, his birthday was the 25th of November at which time he was twenty years of age. His outlook seemed improved, and he remarked to his friend, Ann Cooper, that his financial situation appeared to be improving, possibly reflecting money he had received for his birthday.

e. On the day preceding Danny's death his difficulties again appeared to mount. As indicated in the detailed inset on the attached time line, that morning he had hitchhiked a ride to work. Before he reached the base, however, he had to ask his driver to stop so he could vomit by the side of the road. Danny had to then obtain a second ride and by the time he reported for duty he was sufficiently late to be counseled for tardiness. A letter of counseling was also to be drafted to record this infraction. That afternoon Danny returned to the hospital stating that he was "throwing up blood" and following examination, he was scheduled for x-rays and further evaluation at a later date. Danny's reaction to his counseling for being late was described as being quite intense. He was annoyed that several black members of his squadron had

repeatedly been tardy, and that very day one of those individuals was late for work, yet none of the blacks in the squadron appeared to be counseled or reprimanded for their lateness.

f. On the morning of his death, Danny was described as being quite upset when he could not find his beret. His wife had noted the irrationality of his anger over that frustration, considering it to be unusual. Danny also made some statements which appeared peculiar at that time and which appear to be quite important in retrospect. Danny apparently presented his wife with checks that had been planned for repairs on his car, suggesting that she sell the automobile and return to New York. This is noteworthy because despite the many frustrations the automobile had caused him, Danny seemed to take great pride in the car. Giving it away may have constituted a form of settlement which is frequent among individuals who prepare for their death. Further, when leaving his wife that morning he did not kiss her good-bye, which may have been a purposeful act to indicate his dissatisfaction and contained special meaning for the couple. After he arrived at work the letter documenting the prior day's counseling was delivered. Receipt of that letter may have compounded this young man's disappointment in his job, himself, and potential to persevere. A short while later Danny's truck was inspected, and he had to be requested to pick up papers and otherwise clean the truck, something which Danny would have been expected to have done on his own. Thereafter there appeared to have been a few informal discussions with people he met, but less than an hour later Danny was found with the shotgun wound in his heart.

3. Discussion: From all of the interviews that were conducted in this investigation there are several consistencies that are noteworthy. Danny was described as an individual of great personal pride and independence who, at the same time, was quite private. He had numerous friendships but no one was identified who considered him or herself to share a particularly close relationship. Rather, Danny was described as investing himself almost totally in his family and his job. Several signs of disappointment in his work have already been discussed and although less is known about the quality of his marriage there were also several indications of marital disappointment.

a. The Smith's home was described as being conspicuously unkempt and Danny had remarked that he was annoyed by his wife's laziness. One indication of his disappointment was found in the spiral notebook which contained the suicide note. In that notebook was an undated letter to his parents in which Danny remarked how his wife was now less bothered by having to care for the baby and the house. While only closest friends knew of these marital difficulties, all interviewees were knowledgeable of the couple's financial problem. In fact, interviewees of similar rank and family responsibility remarked that they were able to have a modest but comfortable lifestyle, and they wondered why Danny and Debbie owed so much, yet owned so little.

b. For Mrs. Smith information that Danny had shot himself in the heart appeared to have special meaning. When told how Danny died, she was reported to have spontaneously remarked "that's what hurt him most", adding, "I told him to see a psychiatrist." Finally, a note in the Smith home may further clarify Danny's behavior the morning of his death. Although undated and unsigned, this message implied that Debbie had told Danny of her disappointments with him, and suggested that they should separate.

4. Conclusions: In conclusion, the deceased appeared to have been a highly motivated and well dedicated young man. He seemed to strive to do his best and be personally responsible for success in his career and marriage. Yet, he also appeared to have an overriding sense of pride and independence, which would not permit him to seek supportive outlets during the long period of escalating stress that preceded his death. Depressed individuals who isolate themselves emotionally are considered by mental health professionals to be a high risk for suicide. They sense irreversible failure in their efforts to persevere and often end their lives in a manner that is sudden, violent and without a means of rescue. Clinical indications evident in Danny's behavior support the conclusion that although suicide may not have been predicted, it appears the most supportable explanation of this death.

## 1977

### Last Two Days

December

Car Trouble

Had to hitchhike ride to work

1 Vomited by Roadside

Hitchhiked 2nd Ride

Late to Work -
Counseled for tardiness

HV: "Vomited Blood"

Upset over not finding beret

Presented checks to wife
to fly home

2 Instructed wife to sell car -
as he would "not need it"

Didn't kiss wife good-bye

Received Letter of Counseling

Truck was dirty at inspection

Suicide Note

Wound to Heart

### Five Month Period Preceding Death

June

Transfer to A Flight:

Repeated tardiness
Unkempt appearance
Felt unappreciated

August

Lost Off Base Job:
Accused of theft
Job for friend backfired

31 Hospital Visit (HV):

Viral gastroenteritis

September

2 HV: Physical Examination

Gastroenteritis

October

16 HV: Stress Reaction

Fatigue, Diarrhea,
Dizziness, Slurred
Speech, "long psych
history of job and
marital problems:

November

7 HV: Flu Syndrome

14 HV: Cough, cold, some
fever, headache

15 HV: Sinusitis; Asthma

17 HV: Sinusitis (Recovering)

18 Civil Court Trial:
Not guilty in theft of
fan from prior employer

24 Thanksgiving

25 Birthday

**TIME LINE**

BLANK PAGE

NOTES

NOTES

* * * * *

# Forensic Pediatrics

* * * * *

**BASIC DEATH INVESTIGATION**

**CJ 401**

FORENSIC PEDIATRICS

Instructor:
Arthur E. Westveer
FBI Academy
Quantico, Virginia

1. FORENSIC PEDIATRICS

2. Deaths in Childhood

   a. Infanticide
   b. Sudden Infant Death Syndrome
   c. Accidental Death

3. Infanticide

   The murder of an infant soon after birth

4. Infanticide - Elements

   a. The infant was born alive.
   b. Death results from violence or willful act or omission.
   c. Act or failure to act done with the intent to harm.

5. Criteria for Live-born

   a. Air in the lungs
   b. Air in the stomach
   c. Food in the stomach

6. Float Test of Lungs

   Non reliable

7. Presence of Food in Stomach is Absolute Proof of Live Birth

8. Causes of Death

   a. Asphyxia - Most Common
   b. Craniocerebral
   c. Stab Wounds

9. SUDDEN INFANT DEATH SYNDROME (SIDS)

10. SIDS - SINGLE MOST COMMON CAUSE OF DEATH UNDER ONE YEAR OF AGE

11. WHAT ARE THE CHARACTERISTICS OF SIDS?

In most cases, a well cared for infant between one month and six months of age is put to bed and is found, unresponsive, several hours later. The infant may have exhibited mild cold symptoms, but a thorough autopsy reveals no adequate cause of death.

12. DEFINITION (OLD)

The death of an infant in apparent good health who dies suddenly and unexpectedly and in whose case an autopsy does not reveal a commonly accepted cause of death.

13. DEFINITION (NEW)

Sudden Infant Death Syndrome (SIDS) is the sudden, unexpected death of an infant under one year of age which remains unexplained after a complete postmortem investigation, including autopsy, examination of the death scene, and review of the case history.

14. SIDS - diagnoses of exclusion
Diagnosis should not be made without a full examination and investigation.

15. Frequency

1.0 per 1000 live births
11.0 per 1000 in non-whites

16. Social Background

Congested Urban Areas
Poverty
Illegitimacy
Poor Maternal Prenatal Care

17. SIDS DOES OCCUR IN ALL SOCIO-ECONOMIC GROUPS

18. Sex Incidence

Male - Female Ratio
1.2

19. Age

86% of cases occur between birth and six months.

20. Autopsy Results

Nonspecific
    Petechial Hemorrhages
    Pulmonary Congestion

21. Accidental Death in Childhood

22. BATTERED CHILD
    VS.
ACCIDENTAL INJURY

23. The Abused Children

Child abuse begins at birth in most cases.

Most deaths occur before the age of 5.

Most abuse children will not ask for help.

80% of all sexually related attacks on children are by "natural parents."

24. CHILD ABUSE

"The Battered Child Syndrome"

This year.....

1,000,000 will be abused in the United States

Of these,

1,000 will die as a direct result of child abuse.

25. Types of Child Abuse

Battered Child Syndrome
Physical Neglect
Emotional Neglect

26. <u>Battered Child</u>

Intentional Physical Injury
Inflicted on Infants and Young Children

27. <u>Factors Involved in Child Battering</u>

Parents or Caretaker
The Child
The Environment

28. <u>Morphology of the Battered Child</u>

External Injuries
Skeletal Injuries
Internal Injuries
Ocular Injuries

29. <u>Usual Settings of Child Battering</u>

a. Unexplained Illness or Injury
b. Repeated Physical Abuse
c. Abuse of Parent or Caretaker
d. Delay or Failure to Report Injuries
e. Misleading Medical Attendants

30. <u>Child Abuse (Morphology)</u>

a. External Injuries, Burns, Abrasions and Bruises of Different Ages

Lacerations of Frenulum
Bite Marks

31. b. Internal Injuries

Head Injuries
Most common cause of death

Abdominal Injuries

32. c. Skeletal Injuries

Avulsion of Metaphyses
Multiple Rib Fractures
Long Bone Injuries
Skull Fractures

33. **When Unexplained Fractures are Found, Suspect Child Abuse.**

34. **Neglect**

**Deprivation of Adequate Nutrition or Environmental Needs**

BLANK PAGE

**Pediatrician**
Editor-in-Chief: D.W. Kaplan, Denver, Colo.

**Reprint**
Publisher: S. Karger AG, Basel
Printed in Switzerland

Sudden Infant Death Syndrome
Pediatrician *15:* 191–197 (1988)


0300–1245/88/0154–0191$2.75/0

# Investigation of Sudden Infant Deaths

*J.E. Smialek*[a], *Z. Lambros*[b]

[a] Department of Pathology, University of Maryland School of Medicine, Baltimore, Md., and [b] Havre de Grace, Md., USA

**Key Words.** Sudden infant death syndrome · Scene investigation · Circumstances of death

**Abstract.** The diagnosis of SIDS depends on an analysis of information derived from two primary sources: the scene investigation and the autopsy examination. This paper identifies those details that an observer should look for and consider in completing a report of the circumstances of the death.

In order to reach a proper conclusion as to the cause of death of a person who dies suddenly and unexpectedly, a thorough investigation of the circumstances of the death and a complete autopsy examination are necessary. Both components, the investigation and the autopsy, are essential if a reliable conclusion is to be drawn. Omission of one of these elements can place the entire cause of death in question. This fundamental principle of death certification applies to anyone who dies suddenly and unexpectedly regardless of age. However, only during the past two decades has this criteria been applied to cases of sudden and unexpected infant death.

## Recent History of Sudden Infant Death Syndrome Investigation

The new focus of infant death investigation was triggered in 1972 by the efforts of concerned professionals, parents and legislators when a joint US Congressional Resolution called upon the National Institute of Child Health and Welfare to make investigations into crib death one of its priorities [1].

Preliminary studies by the Office of Maternal and Child Health (OMCH) identified that the problems facing SIDS parents were multiple. First of all, there was a prevalent attitude of suspicion held by many law enforcement personnel as well as physicians and the general public regarding the culpability of the SIDS parents in the death of their infant. Secondly, the OMCH identified that death investigation in this country has historically been treated as a state and local responsibility and is governed by a set of inconsistent and often parochial state laws that were often inadequately supported. The initial approach of the OMCH to the problems identified was to commission a study of state death investigation laws [2], to publish Nosology Guidelines for Sudden Infant Death Syndrome [3], to provide uniform guidelines for infant death investigation [4] and to provide follow-up counseling and education to families and those impacted by the infant's death (in 1975, the Office of Maternal and Child Health of the US Department of Health, Education and Welfare awarded 24 community-based SIDS information and counseling grants).

Uniform guidelines for infant death investigation were developed in 1975 in Sante Fe, N. Mex., at a meeting sponsored by OMCH. This meeting was attended by experts in death investigation and infant mortality. A report of the consensus opinion of that group was published in 1976 [5]. As a reaction to the prevalent belief

held by law enforcement and health professionals that many of these deaths were the result of parental neglect, the meeting focused on the importance of the autopsy examination and de-emphasized the role of scene investigation. The consensus of that meeting was that, while an investigation of the circumstances formed an important component of the determination of the cause of death, the investigation should be conducted a minimum of 2 weeks but preferably 1 month after the death by a person 'thoroughly acquainted with all the nuances of SIDS, but not identified with a punitive agency' [5, p. 835]. It was agreed that the appropriate person should be a public health nurse.

A reexamination of this approach to death investigation reveals certain inherent defects. Firstly, the gathering of critical information is delayed and possibly lost forever due to the fact that many families of SIDS victims move during the early days after death. Secondly, accurate documentation of the scene of the infant death is precluded. Environmental conditions can change and cannot be reproduced. Essential details of the sleeping environment can be omitted due to the discarding of cribs, mattresses, covers or pillows. In addition, if the death investigation takes place at some extended time after the death and such an investigation is considered essential to making a proper certification of death, such certification will obviously need to be delayed.

A second inherent defect is that the public health nurse is placed in a conflict of interest situation when she is charged with a dual role of death investigator and grief counselor. What should be the role of the public health nurse when called upon to counsel a family regarding SIDS when she then learns of the existence of a faulty crib in the home and the possible role that it played in the infant's death?

A third problem with the 1975 investigative protocol was that it did not seek certain essential information including the identification and interviewing of the person who first discovered the infant, documentation of where the infant was found and whether his airway had been compromised or obstructed. Neither was there a provision to identify and interview the treating physician to ascertain if the family had a history of questionable child care practices. There was also no provision to contact protective services to determine if the family had an open case file. While the guidelines were presented as being only the minimum data necessary to be obtained prior to autopsy, the emphasis on the nonpunitive approach created certain gaps in the information identified as being relevant.

The importance of contacting the treating physician is illustrated in the following case, investigated by the authors in Wayne County, Mich.

A 4-month-old infant, reported as being in good health, except for prior treatment for a lung infection at 2 months of age, was found dead at home in his crib. The initial investigation revealed that the child had been under the care of a babysitter while the mother worked. There were no external signs of injury. An autopsy was performed and no significant abnormalities were detected except for a slightly reddish-purple zone 1 ½ inches in diameter on the surface of the cerebral hemispheres, visible beneath the leptomeninges. There was also some flattening of the surface of the brain. Following fixation, this zone was found to represent a cerebral contusion which had most likely resulted from a blow to the top of the head.

A follow-up investigation revealed that the hospitalization of the infant at 2 months of age had been for a superficial skull fracture, rather than a lung infection. The babysitter, when interviewed, revealed that she had not cared for the infant during the several days prior to the initial hospitalization. Neither had she cared for the infant during the 2 weeks prior to his death. The babysitter did state, however, that the infant occasionally would have bruises on his body when he came to her home.

Further investigation revealed that the father had been the primary caretaker of the infant prior to death and a child of his from a previous marriage had died of a subdural hemorrhage. The manner of death had been classified as accidental in that prior case. When the father was interviewed by the police, he admitted that he had struck both infants on their heads with the sole of his shoe because they wouldn't stop crying.

In the 15 years following the US Senate Resolution calling for research into the SIDS, a wealth of information has accumulated in the medical literature regarding the possible causes and mechanisms of death in this group of infants [6]. Valdes-Dapena and Huff [7] have published an excellent manual setting out those procedures necessary for compiling a proper infant autopsy. However, the role of the investigation in the identification of SIDS victims was basically ignored by SIDS researchers. In fact, any detailed investigation conducted by medical examiners and law enforcement individuals was regarded as largely unproductive and potentially damaging to the mental health of the SIDS parents. The authors have observed over the decade following the Resolution, an increasing tendency amongst medical examiners, pathologists and coroners, to accept the autopsy results as the sole requisite of a SIDS diagnosis. The importance of the investigation was largely given lip service. Several dramatic reports in the media of multiple murders of infants by suffocation, jarred the medical community and SIDS families into the harsh realization that when investigations are lacking or inadequate, the

validity of a SIDS diagnosis can be easily discredited [8].

Over an 8-year period in Wayne County, Mich. (Detroit) from 1974 to 1982, the authors investigated approximately 1,100 sudden infant deaths. Approximately 75% of these infants were ultimately classified as SIDS [9]. The remainder were identified as dying as a result of other natural, accidental or homicidal mechanisms. An evaluation of the circumstances surrounding the deaths of most of these infants took place in spite of the fact that approximately 50% of the 1,100 had been transported to emergency rooms by either the parents, police or ambulance.

It is not the purpose of this paper to identify those conditions that may initially appear as a SIDS but are correctly identified at autopsy. These natural disease processes as well as evidence of subtle and obvious signs of child abuse and accidental injury have been adequately documented elsewhere [10].

Rather, the remainder of the paper will focus on the criteria that these authors use in reaching a diagnosis in those difficult cases where there are no demonstrable findings at autopsy and questions of a suspicious or suggestive nature involving the circumstances of the death exist.

## Indications for Supplemental Testing, Obtaining Samples for Specialized Testing

It is important to digress slightly at this point to state that the SIDS diagnosis is most appropriately used when a gross autopsy examination is carried out along with auxiliary examination such as histology. It is not the position of the authors that toxicology, virology or bacteriology studies should be carried out on all infants. Rather, such studies should be utilized when the information collected at the scene suggests the presence of a drug or other agent.

In a study of 130 consecutive cases of sudden deaths of infants under 1 year of age in Wayne County in 1978, toxicological studies were carried out looking for substances including alcohol, barbiturates, opiates and organic bases [11]. No instances of drugs causing or contributing to death were identified in the above study, except in those instances where they had been suggested by evidence collected in the course of the investigation. This led to the policy in Wayne County, of conducting toxicological studies where it was warranted by scene investigation or by a parental history of drug use.

On the basis of these criteria, it was determined that at least 1 infant died as a result of methadone intoxication ingested from the breast milk of the mother who was being maintained on methadone. Another infant death caused by methadone intoxication was the result of 2 small siblings feeding their father's weekend bottle of methadone to their infant brother [12]. A recent unpublished case from Wayne County was related to the authors in which cocaine intoxication was the cause of death in a breast-fed infant of a cocaine-addicted mother [personal commun. from Dr. Haresh Mirchandani, Deputy Chief Medical Examiner, Wayne County, Mich.].

Reports in the literature describe poisonings under 1 year of age from ingestion of a number of noxious agents which include, in part, insecticides by inhalation, oral ingestion of insecticides on nipple of bottle, errors in drop dosage, spider bites and accidental ingestion of drugs, plants and hydrocarbons [13]. This is not to say that large numbers of infants are dying from environmental toxins or medication overdoses. Merritt and Valdes-Dapena [10, p. 204] have stated that it is their belief that such deaths do not commonly masquerade as SIDS. It is also the belief of the authors that when a timely and adequate scene investigation is carried out, the investigator should be able to identify such factors which will lead to the appropriate toxicological tests being ordered.

Other authors have stated that botulism is an occult cause of at least a small percentage of sudden infant deaths and may not be evident from the autopsy alone [14]. A history of the use of honey as a sweetener for the formula or the pacifier may suggest this as a possible factor to consider. In an unpublished study by the authors, no positive cases of botulism were identified in 130 consecutive cases of sudden infant deaths under 1 year in Wayne County in 1978. Microbiological analysis and toxin studies of samples from these victims were carried out in conjunction with the Michigan Department of Health. Control samples had provided positive cultures and toxin tests after transportation to the laboratory in a variety of weather conditions.

## Interpretation of Postmortem Changes and Injuries

When infants die in unsanitary environments, the body may be altered by the feeding activity of insects (roaches, ants) or rodents (rats). It is important for investigators to document the presence of such scavengers at

the death scene, since the changes they cause on the body can easily be mistaken as evidence of child abuse [15].

A common finding at the scene of death of a SIDS victim is the intense pulmonary edema evidenced by froth exuding from the nostrils and sometimes the mouth. Occasionally, this froth may be bloody, resulting in prominent staining of the bed linen if the child has been lying on his side or face down. The blood can result from the intense pulmonary capillary congestion that may be secondary to the bradycardia experienced by some of these infants prior to death [personal commun. Dorothy Kelly, Pulmonary Lab, Massachusetts General Hospital, Boston, Mass.].

When circulation ceases, blood will pool by gravity to the lowermost parts of the body. This pooling becomes prominent as a purplish discoloration which can resemble bruising. This discoloration is called livor mortis or lividity. Evaluation of the pattern of lividity present on the body can assist the investigator in determining what the position of the body was at the time of and following death. Knowingly or unintentionally, families may provide inaccurate information as to the location of the body when first observed. One example of the importance of this kind of information is illustrated by the following case history.

> An infant was brought to the emergency room with a history of having been found dead in the crib. On external examinaton, it was observed that the only evidence of lividity present on the body was intense discoloration of both lower legs and feet – similar to that seen in hanging victims. Investigation of the scene and interviewing the family revealed that the infant had been found with his head trapped in a crevice at the top of a crib which had compromised the circulation of blood to the brain. The parents admitted that they had covered up the circumstances of the death because they felt guilty about not having complied with instructions from the crib manufacturer. They had been sent a kit that would have eliminated the dangerous crevice. The kit had arrived 2 days prior to the death but had not been installed. (An infant investigated by the authors who initially presented as a probable SIDS, Wayne County, Mich.)

Another significant scene finding is evidence of regurgitation of formula from the mouth or nostrils of the deceased infant onto the pillow or bedding. This finding is sometimes misinterpreted as an indication that the victum died of aspiration. However, when a person dies and the muscles of the body become flaccid, the sphincters relax resulting in drainage of fluids from body orifices. This represents an agonal or postmortem event. In the case of the infant who dies shortly after a feeding, relaxation of the esophageal sphincter may result in drainage by gravity of fluid from the stomach into the nose and mouth [15, p. 474, 16, 17].

Another physical finding that may mislead the investigator is the postmortem congealing of fat which results in indentations in the skin from tight clothing. When the sleeper is tight at the neck, the resulting mark on the skin can resemble ligature strangulation [15, p. 501].

### Identifying Accidental Mechanisms of Death

Since the autopsy alone may be insufficient to differentiate between SIDS and suffocation, or death due to a compromised airway, it is extremely important for the scene investigator to personally interview the individual who was caring for the infant at the time he died and also to interview the first person who discovered the child [15, p. 475]. The authors investigated 16 accidental deaths of infants which occurred as a result of unsafe sleeping environments in Wayne County in 1974–75 [18]. Such unsafe environments can include defective cribs, defective side rails on beds [19], mattresses that are pushed together, mattresses that are too soft, mattresses that are too small for the bed allowing a space between the head or foot boards, and pillows or other objects in the bed that can compromise the infant's ability to maintain an unobstructed airway. All of the above sleeping situations can allow an infant to slip down between mattresses or between the mattress and the side of the bed or a wall and become trapped. Other unsafe sleeping situations include plastic covers in the bed that can become loose and adhere to the face of the infant to block the entrance of air into the nose and mouth, pacifiers that are manufactured in pieces (rather than molded) [20] can come apart and be aspirated by the infant. Cords around the neck can effectively become a ligature for accidental strangulation [19, p. 88]. Other unsafe environments are created when the infant has access to small objects which can become lodged in his airway. Usually such objects can be identified by autopsy. However, on occasion, manipulation of the airway during resuscitation procedures can dislodge the foreign body to another site in the pharynx where it can escape detection if the examination is not extremely thorough [personal obs., 1985].

While it is certainly true that accidental suffocation or strangulation of infants can occur as a result of unsafe sleeping arrangements, it must be emphasized that this information should not be viewed as implying that large numbers of SIDS infants have been dying of suffocation [6, p. 25]. In the experience of the authors and others, the investigation of the scene will reveal whether traumatic

asphyxia was a likely mechanism in the death of the infant [21].

In cases of this type described in the literature, the infants who had been accidentally suffocated were in the younger age group (1 month) [21, p. 485]. This is significant because it has been noted that for some reason, there is a sparing of SIDS infants in the first month of life. Thus, 'the age distribution of SIDS is inconsistent with this hypothesis' [6, p. 25].

Another scene finding that may be mistakenly implicated in the death of the infant is the presence of bed clothing over the face of the child. It has been determined that ordinary, porous materials such as sheets or blankets are probably not capable of producing suffocation [22].

### Identification of Cases of Infanticide

Homicidal suffocations are usually perpetrated by a deeply disturbed parent or caretaker. However, the authors are aware of at least one instance when an uneducated parent made a practice of quieting the infant's crying by placing a pillow over the face and pressing softly until the crying ceased. On one occasion when the pillow was removed, the infant was found to have stopped breathing. Other suffocation deaths that can masquerade as SIDS include drowning or blockage of the mouth and nose by plastic 'baggies' or other soft objects [19, personal obs.].

It has been recognized that infant autopsy findings in cases of suffocation can be the same as those found in the infant who dies of SIDS [23]. However, signs of suffocation can be more visible depending on how much force is used. Signs of homicidal suffocation which may be present in a victim include conjunctival petechial hemorrhages, abrasions or scratches in the skin of the nose or mouth, bruises or tears of the mucous membrane of the gums and lips and swelling of the brain (cerebral edema). All or none of these findings may be present in a particular case. However, a careful search must be made if such evidence is to be identified.

There are a number of red flags to alert the investigator of the need for a more intensive investigation. Parents who perpetrate such crimes can sometimes be identified when they give inconsistent stories about the death to other family members, friends, physicians or investigators [24]. Severe depression or mental illness of the mother, father or caretaker, more than one unexplained infant death in the family, a prior history of child abuse or neglect of the deceased infant or a sibling, prior unexplained collapses of the infant necessitating emergency treatment, or prolonged periods between the collapse and the notification of emergency medical or law enforcement personnel are additional indicators of a possible unnatural event.

A recognized characteristic of abusive parents is their absence from the bedside of their hospitalized child. However, the authors have observed that the immediate grief reactions of parents rarely differed regardless of the final mechanism of death; i.e., parents of abused children were often just as distraught as parents whose children died naturally [18]. It has been reported that parents who suffocate their infant may even engage in prolonged efforts to revive the child [24].

It must be emphasized, however, that the existence of one or more of the above factors does not necessarily imply that the death was a homicide. Reports in the literature describe certain families as experiencing multiple unexplained deaths of infants [25]. There are even instances when twins have died simultaneously [26].

The authors have investigated the deaths of a number of infants in families that have experienced more than one fatality from SIDS. A family who has lost one infant to SIDS is at a slightly increased risk for losing a second infant the same way [6, pp. 14–16]. The authors have investigated the deaths of several infants in one family who had experienced 5 sudden and unexpected infant deaths. The 2 surviving children underwent extensive medical testing [unpubl. account of 5 sudden infant deaths in one family from the Children's Hospital Medical Center, Boston, Mass. and the Michigan Regional SIDS Center]. The surviving 8-year-old girl was identified as having a seizure disorder and the surviving infant had episodes of apnea (30 s). This last infant was maintained on an apnea monitor for the first year of life. The present status of these children is unknown.

In a recent controversial study of death scene investigation of sudden infant deaths in new York, Bass et al. [27] alleged that 26 consecutive cases of sudden infant death were misdiagnosed by the New York City Medical Examiner. In 2 cases, Bass et al. ignored autopsy findings consistent with SIDS and, based on a history of infant shaking, diagnosed 2 deaths as shaken baby syndrome [27, cases No. 13 and 17]. As support for this conclusion, the authors utilized a 1968 article which related spinal injury to SIDS [28]. This article had been refuted in the same journal the following year [29]. The term, shaken baby syndrome, was originally developed to describe 'a clinicopathological entity occurring in infants character-

ized by retinal hemorrhages, subdural and/or subarachnoid hemorrhages and minimal or absent signs of external trauma' [30]. At autopsy, these entities are clearly demonstrable and are certainly not consistent with SIDS. Furthermore, the concept that shaking alone can cause the severe head injury of the type described above has come under recent scientific scrutiny and probably has been repudiated [30].

## Identification of Environmental Mechanisms of Death

When the history of the child reveals that he has been lethargic or has vomited prior to death, it is especially important to rule out environmental or infectious causes of death. A 2-week-old infant in Franklin County, Ohio, was diagnosed as dying as a result of chemical toxicity from the fumes produced by a solvent in the stain on his basket crib. The diagnosis was based on toxicological studies which identified significant levels of hydrocarbons in the tissues of the infant [30].

Parents often have questions about the role that insecticides or paint play in their infant's death, especially if the house had recently been fumigated or painted before the child died. If such questions are identified before the autopsy, special toxicological tests can be performed either locally or in special reference labs.

Deaths due to carbon monoxide poisoning produce a characteristic cherry red discoloration of the lividity on a body. Such discoloration is readily apparent to a trained investigator. However, if any question exists regarding a possible source of carbon monoxide in the sleeping environment (such as a portable heater), a small sample of blood can be readily tested to identify the presence or absence of significant levels of carboxyhemoglobin.

Excessive heat has been implicated as a cause or contributory factor in some infant deaths [6, p. 21]. In order for this mechanism to be implicated in the death, proper documentation of the environmental temperature should be obtained. In one case which the authors observed, the intense heat was obvious in the closed room where the infants slept. Both children exhibited obvious signs of dehydration.

## Conclusion

In order for the diagnosis of SIDS to withstand possible intense scrutiny, the investigation must be thorough and professional. All concerned in the case study must recognize that the investigative data is as important as the information gathered at the autopsy and, in some cases, the investigation alone provides the solution to the question of why an infant suddenly died.

## Acknowledgment

The authors wish to thank Carol Castellaw for her loyal assistance in the preparation of the manuscript.

## References

1 Congressional Record, 92nd Congress, 2nd Session, June 7, 1972, *118:* 19985–19992.
2 DHEW, Death Investigation: An analysis of laws and policies of the United States, each state and jurisdiction; pub. No. (HSA) 78-5252 (DHEW, Washington 1978).
3 US Department of HEW, PHS, HRA, Rockville, Md., 20852: Nosology guidelines; sudden infant death syndrome, April 1975.
4 DHEW: The investigation and post mortem examination of death from the sudden infant death syndrome (SIDS); pub. No. (HSA) 76-5150 (DHEW, Washington 1976).
5 Jones, A.M.; Weston, J.T.: The examination of the sudden infant death syndrome infant: investigative and autopsy protocols. J. Forensic Sci. *21:* 833–841 (1976).
6 DHEW: The sudden infant death syndrome: pub. No. (HSA) 80-5251 (DHEW, Washington 1975).
7 Valdes-Dapena, M.; Huff, D.: Perinatal autopsy manual (AFIP, Washington 1983).
8 Bass, M.; Kravath, R.; Glass, L.: Death scene investigation in sudden infant death. New Engl. J. Med. *315:* 100–105 (1986).
9 Smialek, Z.: Observations on immediate reactions of families to sudden infant death. Pediatrics *62:* 160–165 (1978).
10 Merritt, T.A.; Valdes-Dapena, M.: SIDS research update. Pediatr. Ann. *13:* 193–207 (1984).
11 Smialek, J.E.; Monforte, J.R.: Toxicology and sudden infant death. J. Forensic Sci. *22:* 757–762 (1978).
12 Smialek, J.E.; Monforte, J.R.; et al.: Methadone deaths in children: a continuing problem. J. Am. med. Ass. *238:* 2516–2517 (1977).
13 Rauber, A.: Poisoning in children under 12 months of age. Clin. Toxicol. *8:* 391–397 (1975).
14 Arnon, S.S.; et al.: Honey and other environmental risk factors for infant botulism. J. Pediat. *94:* 331–336 (1979).
15 Smialek, J.E.: Medicolegal investigation of death; in Spitz, Fisher, Sudden infant death syndrome, chapt. 18, p. 475 (Thomas, Springfield 1980).
16 Baker, S.P.; Fisher, R.S.: Childhood asphyxiation by choking or suffocation. J. Am. med. Ass. *244:* 1343–1346 (1980).
17 Harris, C.S.; et al.: Childhood asphyxiation by food: a national analysis and overview. J. Am. med. Ass. *251:* 2231–2235 (1984).
18 Smialek, J.E.; Smialek, Z.: Accidental bed deaths in infants due to unsafe sleeping situations. Clin. Pediat. *16:* 1031–1036 (1977).

19 Blackbourne, B.D.: Accidental injuries in children. Clin. Proc., Children's Hospital National Medical Center, Vol. XXX, No. 4, 1974.
20 US Consumer Product Safety Commission: A lethal pacifier. Pediatrics *58:* 853–855 (1976).
21 Sturner, W.; et al.: Accidental asphyxial deaths involving infants and young children. J. Forensic Sci. *21:* 483–487 (1976).
22 Wooley, P.V.: Mechanical suffocation during infancy: a comment on its relation to the total problem of sudden death. J. Pediat. *26:* 572 (1945).
23 Valdes-Dapena, M.: The pathologist and the sudden infant death syndrome. Am. J. Path. *106:* 118–131 (1982).
24 Gilbert, K.: Mother faces psychiatric evaluation – suffocated 15-month-old daughter in house near Hagerstown. The Evening Sun, July 9, 1987.
25 Van Ieperen, L.: Three cot deaths in one family: a case report. S. Afr. J. *63:* 1019–1020 (1983).
26 Smialek, J.E.: Simultaneous sudden infant death syndrome in twins. Pediatrics *77:* 816–821 (1986).
27 Bass, M.; et al.: Death scene investigation in sudden infant death. New Engl. J. Med. *35:* 100–105 (1986).
28 Towbin, A.: Spinal injury related to the syndrome of sudden death ('crib death') in infants. Am. J. clin. Path. *49:* 562–567 (1968).
29 Harris, L.; et al. Am. J. clin. Path. *52:* 289 (1969).
30 Duhaime, A.C.; et al.: The shaken baby syndrome. J. Neurosurg. *66:* 409–415 (1987).
31 Coroner says fumes killed baby. The Columbus Dispatch, Sept. 17, 1987.


Received: March 16, 1988

J.E. Smialek, MD
Office of the Chief Medical Examiner
111 Penn Street
Baltimore, MD 21201 (USA)

# SUDDEN INFANT DEATH SYNDROME (SIDS) INFORMATION FOR POLICE OFFICERS

## INTRODUCTION

Every night many parents across this country go to bed secure in the knowledge that their babies are resting safely in their cribs only to discover their infants lifeless in the morning. Why did their healthy infants die? There was no sickness, trauma or injury to make the death understandable. These families may be shocked and confused. An urgent call for help is made, and you are the first responder.

As the first official person on the scene following the discovery of the lifeless baby, your duties in this situation may seem overwhelming. You realize that these parents are clinging to the hope that *you* can do something to save their infant, though the child is obviously dead. Not only must you try to resuscitate the infant, but you will have to deal with parental reactions ranging from numb silence to violent hysteria. It will soon become obvious to you that there are multiple victims of this tragic disease—the dead infant and the surviving family members.

The first responder must be aware of and sensitive to the traumatic condition of the parents. Life-long feelings of guilt, sibling emotional problems, divorce and even suicide are all too often the results of this tragic event. SIDS (Sudden Infant Death Syndrome) families must be treated with the same degree of compassion and sympathy as other families who lose a much loved infant to any other cause. Though you, as the first responder, cannot do anything to alleviate the parents' sorrow, you can provide emotional support and facts about SIDS which may ease their intense guilt feelings. This will be accomplished only when first responders themselves are knowledgeable about SIDS and sensitized to the needs and responses of the SIDS family.

## WHAT IS SIDS?

SIDS (Sudden Infant Death Syndrome), commonly known as "crib death" or "cot death," is the number one cause of death in infants between one month and one year of age. About 6,500 babies die of SIDS every year in the United States (two per 1,000 live births). Statistics show that there has not been an increase in the number of SIDS cases in recent years, but there is more publicity about them than in the past. SIDS is an extremely widespread condition, occurring in Europe, Australia, Canada, and throughout the U. S. at similar rates. It occurs in both poor and wealthy neighborhoods; in both urban and rural communities.

SIDS is a definite disease which cannot be predicted or prevented, even by a physician. It almost always occurs during periods of sleep. The typical SIDS case involves an apparently healthy infant, usually between the ages of 4 weeks and 7 months, who has suddenly died. No illness has been present; though the baby may have had signs of a slight cold. There is no indication that the infant struggled or cried out while dying. Some-

times, though, the child has obviously changed position at the time of death.

There is evidence that SIDS has been with us since antiquity. In Biblical times it was referred to as "overlaying." Then, as occasionally occurs today, mothers slept with their infants. When a mother woke to find her child dead, it was assumed she had rolled over on him and caused his death.

There is much confusion about SIDS among both the general public and the medical profession. Not until recently has serious medical research on SIDS been conducted. However, doctors are still not certain of its exact causes. One of the hypotheses generally accepted by physicians is that death in SIDS victims occurs as the result of a complete upper airway obstruction. The death which takes place suddenly is not believed to cause pain or suffering.

The *only* way SIDS can be conclusively diagnosed is by an autopsy. Diagnosis is made only after all other causes of death have been ruled out; that is, the autopsy reveals no evidence of a rapidly fatal infectious disease, such as pneumonia or meningitis, or a previously unsuspected abnormality. Knowledge about the cause of death obtained from a thorough autopsy can ease the family's concern and intense guilt feelings.

WHAT SIDS IS NOT:

SIDS is not caused by external suffocation.

It is not uncommon for victims to be found wedged into the corner of their cribs or with their heads covered by blankets. Sometimes the face is turned down into the pillow or mattress or is discolored. Under such circumstances, it is natural to assume the baby smothered. However, SIDS also occurs under conditions where there is no possibility of smothering. Investigators have found that even when infants are covered by bedding, the amount of oxygen is not reduced to the point of causing suffocation.

SIDS is not caused by vomiting and choking.

Sometimes milk or even blood-tinged froth is found around the mouth or in the bedding. This has been shown usually to occur after death. Thus it did not block the internal air passages and cause death.

SIDS is not contagious.

SIDS is not contagious. One twin may be taken by SIDS, yet the other remains alive. SIDS is less common after the first year of life, so older children and adults are not at risk. The common viruses which appear to be associated with SIDS do not survive outside living bodies.

SIDS does not cause pain or suffering to the infant.

SIDS can occur within five minutes, and is probably instantaneous. The babies do

not cry out and often do not show even the slightest trace of having been disturbed in their sleep.

SIDS cannot be predicted.

At this time there is no known way to predict its occurrence, even if the baby saw a doctor the day of the event. Nothing the parents did or failed to do could have prevented its occurrence.

## HOW CAN I TELL IF THE INFANT IS A SIDS VICTIM?

Remember that only an autopsy can determine if a death was due to SIDS. You should make no assumptions about the cause of death. You, as a first responder, can only *suspect* SIDS as the cause of death. Always give the parents the benefit of the doubt and assume SIDS until an autopsy proves otherwise. However, the fact that a healthy infant is suddenly dead may give rise to suspicions. The general appearance of the child in his crib may be misleading. There have been cases, for example, when a case of SIDS has been mistaken for child abuse. Therefore, it is necessary that you, as the first responder, know some of the identifying features characteristic of the SIDS victim as opposed to the abused child. The following table is a list of the general physical characteristics of each. This table will help you to identify the SIDS baby as well as distinguish him or her from the battered child.

Table 1

SIDS versus Child Abuse and Neglect

| SIDS VICTIM | ABUSED AND NEGLECTED CHILD |
|---|---|
| 1. Appears to be sleeping.<br>2. May be twisted in the bed clothing.<br>3. Purple mottled markings on head and facial area.<br>4. Blood-tinged froth around nose and mouth areas. | 1. Adult story does not "sound right": or account for all injuries on baby.<br>2. Disfigurements – welts, burns, bruises, etc. – which may be in different stages of healing, or may be scars.<br>3. Broken bones.<br>4. Siblings bearing marks of child abuse.<br>5. Physical evidence of general neglect of child (e.g., malnourished). |

## AS A POLICE OFFICER, WHAT IS MY ROLE IN THE SIDS SITUATION?

When you, the police officer, are the first to arrive at the scene of a possible SIDS death, several tasks must be performed almost simultaneously. You should first initiate resuscitative efforts if the infant is not obviously dead. You must also conduct an "investigation" that will help determine the cause of death. Finally, you must provide leadership and protection to the SIDS families.

It is essential that you begin resuscitative efforts if the infant is not obviously dead. You may save a life. These efforts involve beginning infant Cardiopulmonary Resuscitation (CPR) and continuing it during the transport of the baby to the hospital. CPR is a technique requiring special training and, in some cases, State certification. If you are not trained in this technique, *do not* perform it. You may do more harm than good—you may kill the one you wish to save. If you are responding with a partner, one of you should assume this duty since it requires your complete attention.

At times, you will find a child displaying the obvious characteristics of death (e.g., rigor mortis and settling of the blood). Under normal circumstances involving a dead baby, you may be legally obligated to leave the body as is and notify the proper authorities, such as the coroner or the medical examiner. SIDS cases, however, are not "normal."

The extreme emotional condition of the parents makes them completely dependent upon you. They are looking to you for help. The best thing you can do for these parents is to make them feel that something is being done. You must understand that often parents cling to the hope that their infant is not dead and can be resuscitated, even when death is apparent. They have expectations that you can save their baby. By starting infant CPR on the obviously dead baby, you at least allow the family to have the memory that professional intervention was attempted. Leave no room for "if's" and "maybe's" (e.g., "If they had only tried, maybe . . . "). These parents will have enough self-imposed guilt and doubt to deal with as the result of SIDS. This does not mean, however, that you are to convey an attitude of false hope. Simply begin resuscitative procedures, inform the parents that everything you can do for the child is being done, and transport the infant to the hospital. To refresh your memory, the basic steps of infant CPR are shown in Figure 1.

In addition to beginning first-aid procedures on the baby, it is your job to conduct an "investigation" of the scene of the death. This involves observing the scene and making mental notes, which should be written down at the earliest opportunity. Certain questions should be asked of the parents to help clarify matters for you. This should be done as a dialogue, as opposed to an interrogation. Do not pressure the parents for answers. They may really not remember details.

At times, certain items should be preserved for further investigation. This can be done by either taking them with the infant to the hospital or by making sure they remain in their original position until the death scene can be thoroughly investigated. It should be emphasized here that a criminal investigation should be conducted *only* after the autopsy has shown positive evidence of an unnatural death. There is no need to put these families through the ordeal and overriding implications of an investigation if all indicators point to SIDS. However, you should be aware of what to preserve, should the need arise.

<u>Evidence to Preserve</u>

- Infant's bedding (sheets, blankets, etc.).

- Objects in crib (toys, bottles, etc.).

- Unusual or dangerous items found near death scene (plastic bags, sharp objects, paint chips, etc.).

- Medications—even adult (Note: you may wish to take with you to hospital).

When the time comes to transport the infant to a hospital, you should take charge of the situation. Make sure you tell the parents where you are taking the child. The parents should be allowed to accompany their baby in the police car. If not, give them clear directions regarding where you are taking their baby. Often the parents are in such a state of emotional shock that they are not capable of driving themselves to the hospital. In this case, make other arrangements to get them to the hospital (e.g., taxicab or neighbor). The parents may also need to be reminded to arrange for the care of the siblings. A member of your police team may volunteer to assist in such details.

Once you deliver the baby into the hands of the Emergency Department staff, there is nothing more you can do for him or her. Your attention is now turned to the family of the SIDS victim.

The reactions of family members to the SIDS incident will be as individual as they are. Many factors can affect these reactions: situation of child's death, meaning child had to the individual, marriage relationship, cultural background. You must not misinterpret or read into these reactions. And you, as the first responder, will have to be prepared to deal with them all.

One of the most common immediate reactions to SIDS is shock and disbelief. This may cause family members to become immobilized—incapable of making decisions. Or this may cause them to act as if nothing has really happened. Externally, it may appear as if the parents are cold and unfeeling. It is not that they do not care, but just that they are having a hard time facing reality.

It will be difficult for you to deal with these parents whose reactions are extreme. Some parents may physically act out their emotions, resulting in hysteria, crying or wailing. Parents may be confused and overwhelmed with guilt feelings, unfairly venting

their anger and frustration on you. When anger is aimed at you, or perhaps your professional capabilities questioned, your natural tendency is to retaliate with your own angry remarks, which only compounds the problems.

How can the police officer help the SIDS survivors in this difficult situation? First, you, as a professional, must be in command of your own feelings and behavior at all times. Act in a calm, efficient manner, exhibiting kind concern. While in the home, make the parents feel that something is being done. Explain what you are doing and where you are taking the child. Take command of the situation and try to protect the family from any further stress. At the hospital emergency room, try to keep the parents informed of the child's status. Be careful of what you say to your colleagues at the hospital. Casual comments such as "smothered" or "injured" may be overheard by the family and cause unnecessary emotional distress. Small, often nonverbal, gestures on your part are very important. By simply sitting with the parents, you are showing them that someone cares. Offer to be of assistance to them—to make phone calls or to get them coffee. A sympathetic ear may be all these parents need.

Be careful not to "diagnose" the child's problem or to speculate on the outcome. Let all medical information come from the emergency room physician. If you have any questions or comments, or wish confirmation that the child is a SIDS victim, discuss these matters privately with emergency room personnel.

The interview following a sudden infant death will be difficult for both you and the parents. You may already have much of the information you need to complete your report. If SIDS is indicated by the emergency physician as the cause of death, you should explain to them about the disease. Reassure them that they are in no way responsible for the death. If you need additional information, explain that the questioning is routine and necessary to complete your report. The emotional state of the parents may be such that you may wish to postpone the questioning.

The questioning should be done as an interview. Ask open-ended questions such as, "How was the baby yesterday?" Do not ask leading questions or suspicious questions (e.g., "You weren't drunk last night, were you?"). Do not ask questions that show you might doubt their capabilities as parents (e.g., "How often did you spank the baby?"). Give your full attention to the parents and listen "actively" to what they are saying.

You will be able to obtain much information if you let the parents tell their story while you actively listen. Encourage them to continue talking by nodding and saying, "Um hm" or "Yes, go on." Try to remain objective—do not express approval/disapproval with any of the actions or facts related. Try not to interrupt except to clarify something they say. If the parents become upset, wait quietly for a minute or two, then encourage them to continue talking by saying something like, "You were saying . . . " At the end of the questioning session, look over your notes to make sure all the necessary information has been obtained.

The time you spend with these families may be brief, but it can have a significant positive impact which influences their recovery from this tragic event.

# PATTERNS OF FATAL CHILD BATTERING

BRIAN D. BLACKBOURNE, M.D.

# Patterns of Fatal Child Battering

Brian D. Blackbourne, M.D.*

Only in the last three decades has the full extent of parental violence upon their children been recognized and medical, social and legal steps been taken to attempt to understand, halt and prevent these tragic events. Prior to 1946 this phenomenon was generally unrecognized aside from infanticide, the killing of a small infant, usually by the mother. In 1946, Dr. John Caffey[1], a Pittsburgh Radiologist reported his observation of a common association of subdural hematoma and fractures of long bones. Siliverman[2], in 1953 demonstrated by x-ray that previously unrecognized old or recent fractures in infants could be demonstrated. In 1955 Woolley[3] noted that in many cases of long bone fractures in infants and small children, the injuries have been willfully inflicted by parents or siblings. This work laid the foundation for Kempe's paper[4] in 1962 in which he proposed the name "Battered Child Syndrome". In England the term "Battered Babe Syndrome" is commonly used, and elsewhere it is known by the names of the two men who contributed to its recognition "Caffey-Kempe" syndrome.

The battered child syndrome may be defined as intentional physical injury inflicted on infants and young children usually by parents or by parents' subsitutes. The physical injury is most commonly mechanial force, but may include injury from heat. An associated form of abuse which may or may not accompany battering is emotional or physical neglect.

The term "Battered Child Syndrome" was immediately successful in gaining attention for this neglected clinical and social problem. Almost over night it became the subject of frequent discussions at medical meetings, in courts, social agencies, the press, and on radio and television. Much has been learned, and much has been written in the intervening 12 years. An apparent increase in the number of cases may actually reflect only an increased awareness among medical, law enforcement, and socal welfare professionals.

## INCIDENCE

The true incidence of the battered child is unknown. From clinical experience, it has been estimated[5], however, that 15-25,000 infants are significantly injured each year in the United States under circumstances suggesting intentional parental abuse. Between 1969 and 1971 hospital admissions for battered child syndrome represented almost three percent of all pediatric ward admissions to the San Francisco General Hospital[6]. Similarly, variations in death certificate reporting make it difficult to access a nationwide number of fatalities. In 1972 in the District of Columbia, with a population of 750,000, seven battered child deaths were documented, in 1973 five deaths. In a five year study in Philadephia between 1961 and 1965 Weston[7] reported 36 infants and children who expired as a result of proven physical injury inflicted by a member of their family, paramour or baby sitter.

## FACTORS LEADING TO CHILD BATTERING

Green[8] has identified three major factors, whose interaction leads to child abuse: the parent's personality characteristics which are incompatible with adequate child rearing and contribute to their abuse proneness; the characteristics of the child that increase the likelihood of his being abused; and immediate environmental stresses which maximize the burden of child rearing.

### The Parent

The family of the battered child frequently falls into the lower socio-economic level. Frequent moving leads to few roots in the community, and separation from other members of their family who may have added significant support to the family and aided in child rearing. It should be stated, however, that the battering parent may be well educated with a stable financial situation and an outwardly stable social background.

The battering parent in more often female than male. Lauer[6], in a series of battered children compared with a control series of children admitted to hospital for other medical problems, showed that the parents of the battered children were significantly younger than the other parents. 21% of mothers and 9% of fathers were 19 years of age or younger. He concludes that this supports the popular notion that young parents with little child rearing experience, their own adolescent problems, and often an unplanned baby are predisposed to child abuse.

It is repeatly stated in the literature that many of the battering parents were victims of harsh discipline or of actual physical abuse from their parents during childhood. This pattern of child rearing can thus be carried from one generation to another.

Frequently one of the adults in the household is not the natural father or mother of the child -- as for example- in common law, stepfather, stepmother situations or where the boyfriend of the mother resides in the house. Love and compassion for the child may be different, under these circumstances, from that of the natural parent, and the frustration tolerance for the usual childhood anoyances may be less.

Another factor which may play a role is a feeling of competition between the abuser and the child for the love of the mother or father of the child. This competitive resentment may develop into real hostile feelings toward the child.

Emotional immaturity is frequently observed in the battering parent. Actual mental illness may occur. Caffey[9] concluded that less than 10 percent of battering parents are severely mentally ill. Kempe[5] reports from his study that in 5 per cent of battering families, one parent had a delusional psychosis and in 5 per cent one parent appeared to be an aggressive psychopath.

One of the many disturbing and difficult to understand features of repeated child abuse is why the other parent does not intervene, forcibly restrain or report the abusing parent to the authorities. The answer is as complicated and as individual as the psychodynamics of child abuse. In the case of a mother whose child is being beaten by her common law husband or boyfriend it may involve fear for her own safety or threats of physical harm to herself or fear that he will leave her if she interferes, economic dependency upon the abuser, or a passive personality which prevents her from standing up for the child.

## The Child

The victim of parental abuse is commonly an infant or small child. Lauer[5], in a series of 130 hospitalized battered children found 63% under two years of age. One child in a family may be the predominant victim of abuse although Lauer found evidence of abuse or neglect of a sibling in 53% of cases where there were siblings. The child may be the product of an unwanted pregnancy, a pregnancy which began before marriage or which for other reason was extremely inconvenient.

An area of the problem, not yet adequately studied, was described by Caffey in 1972[9] as the "Provocative Infant". He states that,"an over reactive, demanding, defiant, and exhausting infant may well paralyzes the overburdened mother's self control temporarily and release violent impulses to rid herself of him". Some estimate the general incidence of provocative infants in the population to be as high as 5 to 10 percent. Adelson[10] in 1961 suggested that, "nine of 44 infants and children studied were killed by their fathers during an emotional outburst triggered by frustration and aggravation from prolonged and repeated crying episodes, defecating in their clothing, persistent harrasment, and other temper-abrading and eroding activities which goaded the fathers to a point were they resorted to excessive violence either as a disciplinary measure or as an outlet for their explosive anger and sense of futility. In this way even these very young victims of brutal assault may contribute to their subsequent injury".

## The Stress

The environmental stresses which may precipitate an episode of physical abuse upon a child may not be of profound nature but are rather an accumulation of the frustations of domestic unhappiness, economic deprivation, social isolation and the 24 hour a day care of one or several small children. Elmer[11], in a study comparing the families of battered children with a group of control families found that the abusive families lived under constant stress of a kind and degree unknown to the non-abusive (normal) families.

## EXTERNAL INJURIES

Some battered children present with such severe cutaneous bruises, periorbital ecchymoses and old scars from lacerations, abrasions and burns that the diagnosis is never in doubt. Others will show such minor external injury, a scabbed abrasion or a small ill-defined bruise on the abdomen or eyelid, that the examining physician or pathologist is surprised to find the multiple healing fractures on x-ray or the profound internal injuries.

Many children have one or two scars from falls, but multiple old or healing scars in a small infant should raise suspicion. Patterned injuries may be recognized by careful examination of cutaneous injuries. Parallel rows of narrow repetitive bruises may indicate blows with a belt. Narrow linear scars or recent abrasions in the shape of a loop may indicate blows with a loop of electrical

cord. Small round burns or healed scars may indicate cigarette burns. Larger burns or old burn scars may suggest scalding with hot fluid or contact with a hot object. Deep lacerations are rare and are probably only seen when a blunt object is used to strike the child. Lacerations on the inside of the lips are not uncommon and can be produced by a hard slap or blow over the mouth with the teeth lacerating the insido.of the lips.

One recognized mechanism of producing burn is to sit a child on a heating appliance in order to dry his wet pants. This may be done by an angered parent attempting to toilet train the child and may result in burns of the buttocks. A very distrubing mechanism of inflicting trauma is the human bite. In this case the parent actually bites the child and may leave a circular pattern of human teeth marks on the skin.

The external examination is also very important to document the child's overall nutrition, his height, and weight and state of cleanliness and hydration. These factors all speak to the adequacy of the physical aspects of parental care.

## INTERNAL INJURIES

Three main categories of internal injuries are seen in battered children: head injuries; abdominal injuries; and fractures of extremities and ribs.

### Head Injury

In two series of hospitalized battered children[6,12], 30% and 25% respectively were admitted for head injury, the majority having either a skull fracture or subdural hematoma or both. Head injury was the most common cause of death in hospitalized battered children[12] and is a frequent finding in battered children seen in a medical examiner's office.

The face and scalp may or may not exhibit external evidence of trauma. Extensive hemorrhage may be present beneath the scalp overlying the skull. The skull may exhibit fracture, either a simple straight line fracture or a severe comminuted and depressed skull fracture. Subdural hematomas are relatively common in battered children. They may occurred alone or in conjunction with cerebral contusions. All these injuries require moderate to severe mechanical force. The child may be dropped or thrown to the floor, thrown down a flight of stairs, swung

by the ankles so the head strikes a wall or other solid object, or repeated blows may be struck to the head by a fist or other blunt object. Caffey[13] has described another mechanism of injury which may result in subdural hemorrhage and intraocular bleeding in the absence any scalp injury to indicate that the child has struck his head. The mechanism he calls "The Whiplash Shaken Infant Syndrome" and results from grabbing an infant by the arms or the thorax and shaking him. It is suggested that permanent brain damage and mental retardation may result.

## Abdominal Injury

Due to the fact that the abdominal wall is soft, very severe trauma may be inflicted upon the abdominal organs without significant injury to the skin or the abdomen. One indication of such a condition is a markedly swollen abdomen. Exsanguinating hemorrhage from large lacerations of liver, spleen or small bowel mesentery and peritonitis from lacerated pancreas or ruptured duodenum are all seen in blunt force injuries of the abdomen. Gornall[14] described a two year old who suffered avulsion of the common bile duct from the duodenum. Any delay in seeking medical attention may contribute greatly to the severity of these injuries or cause death before the child is brought to the hospital. Abdominal injuries are a common cause of death in battered children seen in a medical examiner's office.

## Fractures

Skeletal injuries are an integral part of the battered child syndrome and were the first injuries to be documented as being the result of parental abuse[1,2,3]. Extremity fractures may result from the child being struck, thrown or being grabbed and shaken or the extremity twisted. Fractures of femur and humerus are most common[12]. Metaphyseal avulsion and subperiosteal hemorrhages, demonstrated by x-ray in the healing stage, are also induced by shaking an infant[13].

Rib fractures, frequently multiple and usually posterior, adjacent to their attachment to the vertebra, are relatively common in the battered child syndrome but distinctly uncommon in other forms of trauma in children including falls from heights and automobile crash trauma. The ribs effectively protect the thoracic organs which are infrequently injured in child battering.

Multiple fractures in different stages of healing indicate multiple different episodes of injury. This is a pattern recognized in battered children and thus greatly

aids in making the diagnosis. In a series of 110 hospitalized battered children, O'Neill [12] reported 28 long bone fractures, 20 of whom had evidence of old fractures in various stages of healing.

## BATTERED CHILD vs. ACCIDENTAL INJURY

Once the external injuries, internal injuries and old and recent fractures have been identified a determination must be made as to whether they represent battered child injuries or whether they can be explained by an accidental event. An inappropriate historical explanation for the injuries sustained is often the first clue to a case of child abuse. These discrepancies may be in the age of the injury, the severity of the injury, when compared to the history, or in the mechanism of injury production.

In a case of repeated old and recent injury with documented old scars, x-ray evidence of old and healing fractures, hospital records of previous injuries and social service records of previous complaints and investigations the pattern of child abuse is quite clear. On the other hand, one encounters cases where only recent injuries are present. Here, especially, one must test the injuries against the history provided by the family. Some injuries are of such severity as to be completely inconsistent with rolling off the bed or falling from a high chair. This degree of suspicion should stimulate a youth division or social service investigation.

## NEGLECT

A very distressing phenomenon outside the definition of the Battered Child Syndrome, but within the area of child abuse is neglect, the deprivation of adequate nutrition or evironmental needs. These children, often infants but some up to several years of age are often brought to the hospital dead or moribund weighing little more than their birth weight. They show marked emaciation from malnutrition and dehydration and such poor hygiene that dirt and fecal material may be dried onto the skin. The homes commonly are filthy. Weston [7] in a study of 24 cases of death from child neglect observed that the neglected child was often the youngest in a large family averaging 5 to 7 children. The average age at death was 5 months. A feature of the investigation is the common disparity between the appearance of the child and the presenting story of the parent who may say that the child would not take his feeding, had mild diarrhea for one or two days, or had been sick with an upper respiratory infection.

The incidence of death by neglect is not precisely known. Weston reported 24 deaths in Philadelphia between 1961 and 1965. Luke[15] found two such cases in a two year study of all deaths by homicide under 16 years of age in New York City in 1964 to 1965. In the last two years in Washington, D.C. one death by neglect was identified. Weston concluded from the ages of the victims in his study that in an urban environment if a neglected child survives to 1 year and is able to venture out of the home, neighbors or friends will afford necessary care to enable him to survive.

Autopsy examination of these infants must rule out chronic debilitating disease which might explain the childs failure to thrive. Similarly toxicologic examination must be performed to rule out poisoning, overdose of prescribed medication and to eliminate the possibility of lead poisoning.

The fact that these children reach this degree of malnutrition simply by the witholding of food and drink is well shown by those infants who reach hospital still alive. In the first 24 hours they may gain 5 pounds simply by replacing the fluid their body is lacking from dehydration. In one month in the hospital they may double or triple their admission weight. One such case which was thus rescued from starvation, but released again to the custody of the mother, returned to the hospital dead on arrival, two months later again weighing essentially birth weight.

## CONCLUSION

As long as parents, reacting to their own frustation, aggravation and poorly controlled aggression, inflict injury on their defenseless infants and small children the battered child syndrome will remain with us. Society's only hope to reduce this senseless suffering and death is 1.) To make the public understand the common reasons for this abuse so that parents who know they are susceptible to this can obtain counselling, and 2.) To educate the medical and social welfare professions to recognize the early signs of child abuse so that remedial measures can be taken and further injuries and death can be prevented.

## REFERENCES


1.) Caffey, J.: Multiple Fractures in Long Bones of Infants Suffering from Chronic Subdural Hematoma. Amer J Roentgenol 56:163-173, 1946.

2.) Silverman, F.: Roentgen Manifestations of Unrecognized Skeletal Trauma in Infants. Amer J Roentgenol 69: 413-426, 1953.

3.) Woolley, P.V., Jr., and Evans, W.A., Jr.: Significance of Skeletal Lesions in Infants Resembling Those of Traumatic Origin. JAMA 158: 539-543, 1955.

4.) Kempe, C.H., Silverman, F.N., Steele, B.F., Droegemueller, W., and Silver, H.K.: The Battered-Child Syndrome. JAMA 181: 105-112, 1962.

5.) Kempe, C.H.: Pediatric Implications of Battered Babe Syndrome. Arch Dis Childhood 46: 28-34, 1971.

6.) Lauer, B., Broeck, E.T., and Grossman, M.: Battered Child Syndrome: Review of 130 Patients With Controls. Pediatrics, 54: 67-70, 1974.

7.) Spitz, W.U., and Fisher, R.S.: Medicolegal Investigation of Death. Charles C. Thomas, Springfield, 1973.

8.) Green, A.H., Gaines, R.W., and Sandgrund, A.: Child Abuse: Pathological Syndrome of Family Interaction. Am J Psychiatry 131: 882-886, 1974.

9.) Caffey, J.: The Parent - Infant Traumatic Stress Syndrome; (Caffey - Kempe Syndrome), (Battered Babe Syndrome). Amer J Roentgenol 114: 218-229, 1972.

10.) Adelson , L.: Slaughter of the Innocents. NEJM 264: 1345-1349, 1961.

11.) Elmer, E.: Children in Jeopardy. University of Pittsburgh Press, Pittsburgh, 1967.

12.) O'Neill, J.A., Jr., Meacham, W.F., Griffin, P.P., and Sawyers, J.L.: Patterns of Injury in the Battered Child Syndrome. The Journal of Trauma 13: 332-339, 1973.

13.) Caffey, J.: The Whiplash Shaken Infant Syndrome: Manual Shaking by the Extremities With Whiplash - Induced Intracranial and Intraocular Bleeding, Linked With Residual Permanent Brain Damage and Mental Retardation. Pediatrics 54: 396-403, 1974.

14.) Gornall, P., Ahmed, S., Jolleys, A., and Cohen, S.J.: Intra-abdominal Injuries in The Battered Baby Syndrome. Archives of Disease in Childhood 47: 211-214, 1972.

15.) Luke, J.L., Lyons, M.M., and Devlin, J.F.: Pediatric Forensic Pathology I. Death by Homicide. Journal of Forensic Sciences 12: 421-430, 1967.

NOTES

NOTES

* * * * *

# Criminal Investigative Analysis

* * * * *

# Criminal Profiling from Crime Scene Analysis

John E. Douglas, M.S.
Robert K. Ressler, M.S.
Ann W. Burgess, R.N., D.N.Sc.
Carol R. Hartman, R.N., D.N.Sc.

***Since the 1970s, investigative profilers at the FBI's Behavioral Science Unit (now part of the National Center for the Analysis of Violent Crime) have been assisting local, state, and federal agencies in narrowing investigations by providing criminal personality profiles. An attempt is now being made to describe this criminal-profile-generating process. A series of five overlapping stages lead to the sixth stage, or the goal of apprehension of the offender: (1) profiling inputs, (2) decision-process models, (3) crime assessment, (4) the criminal profile, (5) investigation, and (6) apprehension. Two key feedback filters in the process are: (a) achieving congruence with the evidence, with decision models, and with investigation recommendations, and (b) the addition of new evidence.***

> "You wanted to mock yourself at me! . . . You did not know your Hercule Poirot." He thrust out his chest and twirled his moustache.
>
> I looked at him and grinned . . . "All right then," I said. "Give us the answer to the problems—if you know it."
>
> "But of course I know it."

---

**John E. Douglas, M.S., is Supervisory Special Agent, Federal Bureau of Investigation and Program Manager, Profiling and Consultation Program, National Center for the Analysis of Violent Crime, FBI Academy, Quantico, VA; Robert K. Ressler, M.S., is Supervisory Special Agent, Federal Bureau of Investigation and Program Manager, Violent Criminal Apprehension Program, National Center for the Analysis of Violent Crime, FBI Academy, Quantico, VA; Ann W. Burgess, R.N., D.N.Sc., is van Ameringen Professor of Psychiatric Mental Health Nursing, University of Pennsylvania School of Nursing, Philadelphia, PA; and Carol R. Hartman, R.N., D.N.Sc., is Associate Professor and Coordinator of the Graduate Program in Psychiatric Mental Health Nursing, Boston College School of Nursing, Chestnut Hill, MA.**
Preparation of this manuscript was supported by an Office of Juvenile Justice and Delinquency Prevention grant (84-JN-K010). The authors wish to acknowledge Allen G. Burgess, Cynthia J. Lent, and Marieanne L. Clark for contributions to this manuscript. *Correspondence and reprint requests should be addressed to: John E. Douglas, FBI Academy, Quantico, VA 22135.*

*Behavioral Sciences & the Law*, Vol. 4, No. 4, pp. 401–421 (1986)
 CCC 0735-3936/86/040401-21$04.00

> Hardcastle stared at him incredulously . . . "Excuse me, Monsieur Poirot, you claim that you know who killed three people. And why? . . . All you mean is that you have a hunch."
>
> I will not quarrel with you over a word . . . Come now, Inspector. I know—really know . . . I perceive you are still sceptic. But first let me say this: To be sure means that when the right solution is reached, everything falls into place. You perceive that in no other way could things have happened."
>
> (Christie, 1963, pp. 227–228)

The ability of Hercule Poirot to solve a crime by describing the perpetrator is a skill shared by the expert investigative profiler. Evidence speaks its own language of patterns and sequences that can reveal the offender's behavioral characteristics. Like Poirot, the profiler can say, "I know who he must be."

This article focuses on the developing technique of criminal profiling. Special Agents at the FBI Academy have demonstrated expertise in crime scene analysis of various violent crimes, particularly those involving sexual homicide. This article discusses the history of profiling and the criminal-profile-generating process and provides a case example to illustrate the technique.

## INTRODUCTION: HISTORY OF CRIMINAL PROFILING

Criminal profiling has been used successfully by law enforcement in several areas and is a valued means by which to narrow the field of investigation. Profiling does *not* provide the specific identity of the offender. Rather, it indicates the kind of person most likely to have committed a crime by focusing on certain behavioral and personality characteristics.

Profiling techniques have been used in various settings, such as hostage taking (Reiser, 1982). Law enforcement officers need to learn as much as possible about the hostage taker in order to protect the lives of the hostages. In such cases, police are aided by verbal contact (although often limited) with the offender, and possibly by access to his family and friends. They must be able to assess the subject in terms of what course of action he is likely to take and what his reactions to various stimuli might be.

Profiling has been used also in identifying anonymous letter writers (Casey-Owens 1984) and persons who make written or spoken threats of violence (Miron & Douglas 1979). In cases of the latter, psycholinguistic techniques have been used to compose a "threat dictionary," whereby every word in a message is assigned, by computer, to a specific category. Words as they are used in the threat message are then compared with those words as they are used in ordinary speech or writings. The vocabulary usage in the message may yield "signature" words unique to the offender. In this way, police may not only be able to determine that several letters were written by the same individual, but also to learn about the background and psychology of the offender.

Rapists and arsonists also lend themselves to profiling techniques. Through

careful interview of the rape victim about the rapist's behavior, law enforcement personnel begin to build a profile of the offender (Hazelwood, 1983). The rationale behind this approach is that behavior reflects personality, and by examining behavior the investigator may be able to determine what type of person is responsible for the offense. For example, common characteristics of arsonists have been derived from an analysis of the data from the FBI's *Crime in the United States* (Rider, 1980). Knowledge of these characteristics can aid the investigator in identifying possible suspects and in developing techniques and strategies for interviewing them. However, studies in this area have focused on specific categories of offenders and are not yet generalizable to all offenders.

Criminal profiling has been found to be of particular usefulness in crimes such as serial sexual homicides. These crimes create a great deal of fear because of their apparently random and motiveless nature, and they are also given high publicity. Consequently, law enforcement personnel are under great public pressure to apprehend the perpetrator as quickly as possible. At the same time, these crimes may be the most difficult to solve, precisely because of their apparent randomness.

While it is not completely accurate to say that these crimes are motiveless, the motive may all too often be one understood only by the perpetrator. Lunde (1976) demonstrates this issue in terms of the victims chosen by a particular offender. As Lunde points out, although the serial murderer may not know his victims, their selection is not random. Rather, it is based on the murderer's perception of certain characteristics of his victims that are of symbolic significance to him. An analysis of the similarities and differences among victims of a particular serial murderer provides important information concerning the "motive" in an apparently motiveless crime. This, in turn, may yield information about the perpetrator himself. For example, the murder may be the result of a sadistic fantasy in the mind of the murderer and a particular victim may be targeted because of a symbolic aspect of the fantasy (Ressler et al., 1985).

In such cases, the investigating officer faces a completely different situation from the one in which a murder occurs as the result of jealousy or a family quarrel, or during the commission of another felony. In those cases, a readily identifiable motive may provide vital clues about the identity of the perpetrator. In the case of the apparently motiveless crime, law enforcement may need to look to other methods in addition to conventional investigative techniques, in its efforts to identify the perpetrator. In this context, criminal profiling has been productive, particularly in those crimes where the offender has demonstrated repeated patterns at the crime scene.

## THE PROFILING OF MURDERERS

Traditionally, two very different disciplines have used the technique of profiling murderers: mental health clinicians who seek to explain the personality and actions of a criminal through psychiatric concepts, and law enforcement

agents whose task is to determine the behavioral patterns of a suspect through investigative concepts.

## Psychological Profiling

In 1957, the identification of George Metesky, the arsonist in New York City's Mad Bomber case (which spanned 16 years), was aided by psychiatrist–criminologist James A. Brussel's staccato-style profile:

> "Look for a heavy man. Middle-aged. Foreign born. Roman Catholic. Single. Lives with a brother or sister. When you find him, chances are he'll be wearing a double-breasted suit. Buttoned."

Indeed, the portrait was extraordinary in that the only variation was that Metesky lived with two single sisters. Brussel, in a discussion about the psychiatrist acting as Sherlock Holmes, explains that a psychiatrist usually studies a person and makes some reasonable predictions about how that person may react to a specific situation and about what he or she may do in the future. What is done in profiling, according to Brussel, is to reverse this process. Instead, by studying an individual's deeds one deduces what kind of a person the individual might be (Brussel, 1968).

The idea of constructing a verbal picture of a murderer using psychological terms is not new. In 1960, Palmer published results of a three-year study of 51 murderers who were serving sentences in New England. Palmer's "typical murderer" was 23 years old when he committed murder. Using a gun, this typical killer murdered a male stranger during an argument. He came from a low social class and achieved little in terms of education or occupation. He had a well-meaning but maladjusted mother, and he experienced physical abuse and psychological frustrations during his childhood.

Similarly, Rizzo (1982) studied 31 accused murderers during the course of routine referrals for psychiatric examination at a court clinic. His profile of the average murderer listed the offender as a 26-year-old male who most likely knew his victim, with monetary gain the most probable motivation for the crime.

## Criminal Profiling

Through the techniques used today, law enforcement seeks to do more than describe the typical murderer, if in fact there ever was such a person. Investigative profilers analyze information gathered from the crime scene for what it may reveal about the type of person who committed the crime.

Law enforcement has had some outstanding investigators; however, their skills, knowledge, and thought processes have rarely been captured in the professional literature. These people were truly the experts of the law enforcement field, and their skills have been so admired that many fictional characters (Sergeant Cuff,

Sherlock Holmes, Hercule Poirot, Mike Hammer, and Charlie Chan) have been modeled on them. Although Lunde (1976) has stated that the murders of fiction bear no resemblance to the murders of reality, a connection between fictional detective techniques and modern criminal profiling methods may indeed exist. For example, it is attention to detail that is the hallmark of famous fictional detectives; the smallest item at a crime scene does not escape their attention. As stated by Sergeant Cuff in Wilkie Collins' *The Moonstone*, widely acknowledged as the first full-length detective study:

> At one end of the inquiry there was a murder, and at the other end there was a spot of ink on a tablecloth that nobody could account for. In all my experience . . . I have never met with such a thing as a trifle yet.

However, unlike detective fiction, real cases are not solved by one tiny clue but the analysis of all clues and crime patterns.

Criminal profiling has been described as a collection of leads (Rossi, 1982), as an educated attempt to provide specific information about a certain type of suspect (Geberth, 1981), and as a biographical sketch of behavioral patterns, trends, and tendencies (Vorpagel, 1982). Geberth (1981) has also described the profiling process as particularly useful when the criminal has demonstrated some form of psychopathology. As used by the FBI profilers, the criminal-profile-generating process is defined as a technique for identifying the major personality and behavioral characteristics of an individual based upon an analysis of the crimes he or she has committed. The profiler's skill is in recognizing the crime scene dynamics that link various criminal personality types who commit similar crimes.

The process used by an investigative profiler in developing a criminal profile is quite similar to that used by clinicians to make a diagnosis and treatment plan: data are collected and assessed, the situation reconstructed, hypotheses formulated, a profile developed and tested, and the results reported back. Investigators traditionally have learned profiling through brainstorming, intuition, and educated guesswork. Their expertise is the result of years of accumulated wisdom, extensive experience in the field, and familiarity with a large number of cases.

A profiler brings to the investigation the ability to make hypothetical formulations based on his or her previous experience. A formulation is defined here as a concept that organizes, explains, or makes investigative sense out of information, and that influences the profile hypotheses. These formulations are based on clusters of information emerging from the crime scene data and from the investigator's experience in understanding criminal actions.

A basic premise of criminal profiling is that the way a person thinks (i.e., his or her patterns of thinking) directs the person's behavior. Thus, when the investigative profiler analyzes a crime scene and notes certain critical factors, he or she may be able to determine the motive and type of person who committed the crime.

## THE CRIMINAL-PROFILE-GENERATING PROCESS

Investigative profilers at the FBI's Behavioral Science Unit (now part of the National Center for the Analysis of Violent Crime [NCAVC]) have been analyzing crime scenes and generating criminal profiles since the 1970s. Our description of the construction of profiles represents the off-site procedure as it is conducted at the NCAVC, as contrasted with an on-site procedure (Ressler et al., 1985). The criminal-profile-generating process is described as having five main stages, with a sixth stage or goal being the apprehension of a suspect (see Fig. 1).

### 1. Profiling Inputs Stage

The profiling inputs stage begins the criminal-profile-generating process. Comprehensive case materials are essential for accurate profiling. In homicide cases, the required information includes a complete synopsis of the crime and a description of the crime scene, encompassing factors indigenous to that area to the time of the incident such as weather conditions and the political and social environment.

Complete background information on the victim is also vital in homicide profiles. The data should cover domestic setting, employment, reputation, habits, fears, physical condition, personality, criminal history, family relationships, hobbies, and social conduct.

Forensic information pertaining to the crime is also critical to the profiling process, including an autopsy report with toxicology/serology results, autopsy photographs, and photographs of the cleansed wounds. The report should also contain the medical examiner's findings and impressions regarding estimated time and cause of death, type of weapon, and suspected sequence of delivery of wounds.

In addition to autopsy photographs, aerial photographs (if available and appropriate) and 8 × 10 color pictures of the crime scene are needed. Also useful are crime scene sketches showing distances, directions, and scale, as well as maps of the area (which may cross law enforcement jurisdiction boundaries).

The profiler studies all this background and evidence information, as well as all initial police reports. The data and photographs can reveal such significant elements as the level of risk of the victim, the degree of control exhibited by the offender, the offender's emotional state, and his criminal sophistication.

Information the profiler does *not* want included in the case materials is that dealing with possible suspects. Such information may subconsciously prejudice the profiler and cause him or her to prepare a profile matching the suspect.

### 2. Decision Process Models Stage

The decision process begins the organizing and arranging of the inputs into meaningful patterns. Seven key decision points, or models, differentiate and

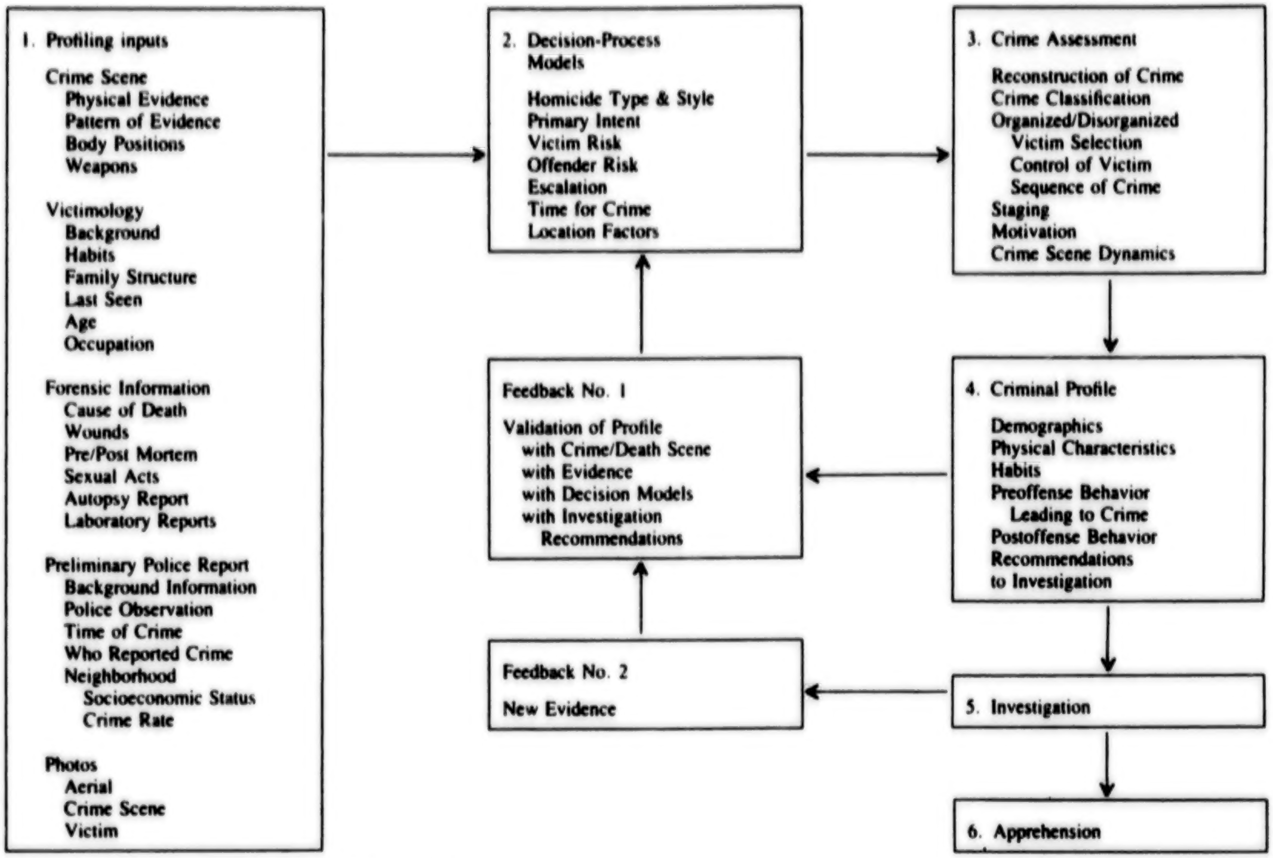



Figure 1. Criminal profile generating process.

organize the information from Stage I and form an underlying decisional structure for profiling.

*Homicide Type and Style*

As noted in Table I, homicides are classified by type and style. A single homicide is one victim, one homicidal event; double homicide is two victims, one event, and in one location; and a triple homicide has three victims in one location during one event. Anything beyond three victims is classified a mass murder; that is, four or more victims in one location, and within one event.

There are two types of mass murder: classic and family. A classic mass murder involves one person operating in one location at one period of time. That period of time could be minutes or hours and might even be days. The classic mass murderer is usually described as a mentally disordered individual whose problems have increased to the point that he acts against groups of people unrelated to these problems. He unleashes his hostility through shootings or stabbings. One classic mass murderer was Charles Whitman, the man who armed himself with boxes of ammunition, weapons, ropes, a radio, and food; barricaded himself on a tower in Austin, Texas; and opened fire for 90 minutes, killing 16 people and wounding over 30 others. He was stopped only when he was killed during an assault on the tower. James Huberty was another classic mass murderer. With a machine gun, he entered a fast food restaurant and killed and wounded many people. He also was killed at the site by responding police. More recently, Pennsylvania mass murderer Sylvia Seegrist (nicknamed Ms. Rambo for her military style clothing) was sentenced to life imprisonment for opening fire with a rifle at shoppers in a mall in October 1985, killing three and wounding seven.

The second type of mass murder is family member murder. If more than three family members are killed and the perpetrator takes his own life, it is classified as a mass murder/suicide. Without the suicide and with four or more victims, the murder is called a family killing. Examples include John List, an insurance salesman who killed his entire family on November 9, 1972, in Westfield, New Jersey. The bodies of List's wife and three children (ages 16, 15, and 13) were discovered in their front room, lying side by side on top of sleeping bags as if

**TABLE I** Homicide Classification by Style and Type

| Style | Single | Double | Triple | Mass | Spree | Serial |
|---|---|---|---|---|---|---|
| Number of Victims | 1 | 2 | 3 | 4+ | 2+ | 3+ |
| Number of Events | 1 | 1 | 1 | 1 | 1 | 3+ |
| Number of Locations | 1 | 1 | 1 | 1 | 2+ | 3+ |
| Cool-Off Period | N/A | N/A | N/A | N/A | No | Yes |

in a mortuary. Their faces were covered and their arms were folded across their bodies. Each had been shot once behind the left ear, except one son who had been shot multiple times. A further search of the residence discovered the body of List's mother in a third floor closet. She had also been shot once behind the left ear. List disappeared after the crime and his car was found at an airport parking lot.

In another family killing case, William Bradford Bishop beat to death his wife, mother, and three children in the family's Bethesda, Maryland, residence in March 1976. He then transported them to North Carolina in the family station wagon where their bodies, along with the family dog's, were buried in a shallow grave. Bishop was under psychiatric care and had been prescribed antidepressant medication. No motive was determined. Bishop was a promising mid-level diplomat who had served in many overseas jobs and was scheduled for higher level office in the U.S. Department of State. Bishop, like List, is a Federal fugitive. There is strong indication both crimes were carefully planned and it is uncertain whether or not the men have committed suicide.

Two additional types of multiple murder are spree and serial. A spree murder involves killings at two or more locations with no emotional cooling-off time period between murders. The killings are all the result of a single event, which can be of short or long duration. On September 6, 1949, Camden, New Jersey, spree murderer Howard Unruh took a loaded German luger with extra ammunition and randomly fired the handgun while walking through his neighborhood, killing 13 people and wounding 3 in about 20 minutes. Even though Unruh's killings took such a short amount of time, they are not classified as a mass murder because he moved to different locations.

Serial murderers are involved in three or more separate events with an emotional cooling-off period between homicides. This type killer usually premeditates his crimes, often fantasizing and planning the murder in every aspect with the possible exception of the specific victim. Then, when the time is right for him and he is cooled off from his last homicide, he selects his next victim and proceeds with his plan. The cool-off period can be days, weeks, or months, and is the main element that separates the serial killer from other multiple killers.

However, there are other differences between the murderers. The classic mass murderer and the spree murderer are not concerned with who their victims are; they will kill anyone who comes in contact with them. In contrast, a serial murderer usually selects a type of victim. He thinks he will never be caught, and sometimes he is right. A serial murderer controls the events, whereas a spree murderer, who oftentimes has been identified and is being closely pursued by law enforcement, may barely control what will happen next. The serial killer is planning, picking and choosing, and sometimes stopping the act of murder.

A serial murderer may commit a spree of murders. In 1984, Christopher Wilder, an Australian-born businessman and race car driver, traveled across the United States killing young women. He would target victims at shopping malls or would abduct them after meeting them through a beauty contest setting or dating service. While a fugitive as a serial murderer, Wilder was investigated,

identified, and tracked by the FBI and almost every police department in the country. He then went on a long-term killing spree throughout the country and eventually was killed during a shoot-out with police.

Wilder's classification changed from serial to spree because of the multiple murders and the lack of a cooling-off period during his elongated murder event lasting nearly seven weeks. This transition has been noted in other serial/spree murder cases. The tension due to his fugitive status and the high visibility of his crimes gives the murderer a sense of desperation. His acts are now open and public and the increased pressure usually means no cooling-off period. He knows he will be caught, and the coming confrontation with police becomes an element in his crimes. He may place himself in a situation where he forces the police to kill him.

It is important to classify homicides correctly. For example, a single homicide is committed in a city; a week later a second single homicide is committed; and the third week, a third single homicide. Three seemingly unrelated homicides are reported, but by the time there is a fourth, there is a tie-in through forensic evidence and analyses of the crime scenes. These three single homicides now point to one serial offender. It is not mass murder because of the multiple locations and the cooling-off periods. The correct classification assists in profiling and directs the investigation as serial homicides. Similarly, profiling of a single murder may indicate the offender had killed before or would repeat the crime in the future.

*Primary Intent of the Murderer*

In some cases, murder may be an ancillary action and not itself the primary intent of the offender. The killer's primary intent could be: (1) criminal enterprise, (2) emotional selfish, or cause-specific, or (3) sexual. The killer may be acting on his own or as part of a group.

When the primary intent is criminal enterprise, the killer may be involved in the business of crime as his livelihood. Sometimes murder becomes part of this business even though there is no personal malice toward the victim. The primary motive is money. In the 1950s, a young man placed a bomb in his mother's suitcase that was loaded aboard a commercial aircraft. The aircraft exploded, killing 44 people. The young man's motive had been to collect money from the travel insurance he had taken out on his mother prior to the flight. Criminal enterprise killings involving a group include contract murders, gang murders, competition murders, and political murders.

When the primary intent involves emotional, selfish, or cause-specific reasons, the murderer may kill in self-defense or compassion (mercy killings where life support systems are disconnected). Family disputes or violence may lie behind infanticide, matricide, patricide, and spouse and sibling killings. Paranoid reactions may also result in murder as in the previously described Whitman case. The mentally disordered murderer may commit a symbolic crime or have a psychotic outburst. Assassinations, such as those committed by Sirhan Sirhan and Mark Chapman, also fall into the emotional intent category. Murders in this

category involving groups are committed for a variety of reasons: religious (Jim Jones and the Jonestown, Guyana, case), cult (Charles Manson), and fanatical organizations such as the Ku Klux Klan and the Black Panther Party of the 1970s.

Finally, the murderer may have sexual motives for killing. Individuals may kill as a result of or to engage in sexual activity, dismemberment, mutilation, eviseration, or other activities that have sexual meaning only for the offender. Occasionally, two or more murderers commit these homicides together as in the 1984–1985 case in Calaveras County, California, where Leonard Lake and Charles Ng are suspected of as many as 25 sex-torture slayings.

*Victim Risk*

The concept of the victim's risk is involved at several stages of the profiling process and provides information about the suspect in terms of how he or she operates. Risk is determined using such factors as age, occupation, lifestyle, physical stature, resistance ability, and location of the victim, and is classified as high, moderate, or low. Killers seek high-risk victims at locations where people may be vulnerable, such as bus depots or isolated areas. Low-risk types include those whose occupations and daily lifestyles do not lead them to being targeted as victims. The information on victim risk helps to generate an image of the type of perpetrator being sought.

*Offender Risk*

Data on victim risk integrates with information on offender risk, or the risk the offender was taking to commit the crime. For example, abducting a victim at noon from a busy street is high risk. Thus, a low-risk victim snatched under high-risk circumstances generates ideas about the offender, such as personal stresses he is operating under, his beliefs that he will not be apprehended, or the excitement he needs in the commission of the crime, or his emotional maturity.

*Escalation*

Information about escalation is derived from an analysis of facts and patterns from the prior decision process models. Investigative profilers are able to deduce the sequence of acts committed during the crime. From this deduction, they may be able to make determinations about the potential of the criminal not only to escalate his crimes (e.g., from peeping to fondling to assault to rape to murder), but to repeat his crimes in serial fashion. One case example is David Berkowitz, the Son of Sam killer, who started his criminal acts with the nonfatal stabbing of a teenage girl and who escalated to the subsequent .44-caliber killings.

*Time Factors*

There are several time factors that need to be considered in generating a criminal profile. These factors include the length of time required: (1) to kill the

victim, (2) to commit additional acts with the body, and (3) to dispose of the body. The time of day or night that the crime was committed is also important, as it may provide information on the lifestyle and occupation of the suspect (and also relates to the offender risk factor). For example, the longer an offender stays with his victim, the more likely it is he will be apprehended at the crime scene. In the case of the New York murder of Kitty Genovese, the killer carried on his murderous assault to the point where many people heard or witnessed the crime, leading to his eventual prosecution. A killer who intends to spend time with his victim therefore must select a location to preclude observation, or one with which he is familiar.

*Location Factors*

Information about location—where the victim was first approached, where the crime occurred, and if the crime and death scenes differ—provide yet additional data about the offender. For example, such information provides details about whether the murderer used a vehicle to transport the victim from the death scene or if the victim died at her point of abduction.

## 3. Crime Assessment Stage

The Crime Assessment Stage in generating a criminal profile involves the reconstruction of the sequence of events and the behavior of both the offender and victim. Based on the various decisions of the previous stage, this reconstruction of how things happened, how people behaved, and how they planned and organized the encounter provides information about specific characteristics to be generated for the criminal profile. Assessments are made about the classification of the crime, its organized/disorganized aspects, the offender's selection of a victim, strategies used to control the victim, the sequence of crime, the staging (or not) of the crime, the offender's motivation for the crime, and crime scene dynamics.

The classification of the crime is determined through the decision process outlined in the first decision process model. The classification of a crime as organized or disorganized, first introduced as classification of Lust murder (Hazelwood & Douglas, 1980), but since broadly expanded, includes factors such as victim selection, strategies to control the victim, and sequence of the crime. An organized murderer is one who appears to plan his murders, target his victims, display control at the crime scene, and act out a violent fantasy against the victim (sex, dismemberment, torture). For example, Ted Bundy's planning was noted through his successful abduction of young women from highly visible areas (e.g., beaches, campuses, a ski lodge). He selected victims who were young, attractive, and similar in appearance. His control of the victim was initially through clever manipulation and later physical force. These dynamics were important in the development of a desired fantasy victim.

In contrast, the disorganized murderer is less apt to plan his crime in detail,

obtains victims by chance, and behaves haphazardly during the crime. For example, Herbert Mullin of Santa Cruz, California, who killed 14 people of varying types (e.g., an elderly man, a young girl, a priest) over a four-month period, did not display any specific planning or targeting of victims; rather, the victims were people who happened to cross his path, and their killings were based on psychotic impulses as well as on fantasy.

The determination of whether or not the crime was staged (i.e., if the subject was truly careless or disorganized, or if he made the crime appear that way to distract or mislead the police) helps direct the investigative profiler to the killer's motivation. In one case, a 16-year-old high school junior living in a small town failed to return home from school. Police, responding to the father's report of his missing daughter, began their investigation and located the victim's scattered clothing in a remote area outside the town. A crude map was also found at the scene which seemingly implied a premeditated plan of kidnaping. The police followed the map to a location which indicated a body may have been disposed of in a nearby river. Written and telephoned extortion demands were sent to the father, a bank executive, for the sum of $80,000, indicating that a kidnap was the basis of the abduction. The demands warned police in detail not to use electronic monitoring devices during their investigative efforts.

Was this crime staged? The question was answered in two ways. The details in one aspect of the crime (scattered clothing and tire tracks) indicated that subject was purposely staging a crime while the details in the other (extortion) led the profilers to speculate who the subject was; specifically that he had a law enforcement background and therefore had knowledge of police procedures concerning crimes of kidnaping, hiding the primary intent of sexual assault and possible murder. With this information, the investigative profilers recommended that communication continue between the suspect and the police, with the hypothesis that the behavior would escalate and the subject become bolder.

While further communications with the family were being monitored, profilers from the FBI's Behavioral Science Unit theorized that the subject of the case was a white male who was single, in his late 20's to early 30's, unemployed, and who had been employed as a law enforcement officer within the past year. He would be a macho outdoors type person who drove a late model, well maintained vehicle with a CB radio. The car would have the overall appearance of a police vehicle.

As the profile was developed, the FBI continued to monitor the extortion telephone calls made to the family by the subject. The investigation, based on the profile, narrowed to two local men, both of whom were former police officers. One suspect was eliminated, but the FBI became very interested in the other since he fit the general profile previously developed. This individual was placed under surveillance. He turned out to be a single, white male who was previously employed locally as a police officer. He was now unemployed and drove a car consistent with the FBI profile. He was observed making a call from a telephone booth, and after hanging up, he taped a note under the telephone. The call was traced to the residence of the victim's family. The caller had given instructions

for the family to proceed to the phone booth the suspect had been observed in. "The instructions will be taped there," stated the caller.

The body of the victim was actually found a considerable distance from the "staged" crime scene, and the extortion calls were a diversion to intentionally lead the police investigation away from the sexually motivated crime of rape-murder. The subject never intended to collect the ransom money, but he felt that the diversion would throw the police off and take him from the focus of the rape-murder inquiry. The subject was subsequently arrested and convicted of this crime.

*Motivation*

Motivation is a difficult factor to judge because it requires dealing with the inner thoughts and behavior of the offender. Motivation is more easily determined in the organized offender who premeditates, plans, and has the ability to carry out a plan of action that is logical and complete. On the other hand, the disorganized offender carries out his crimes by motivations that frequently are derived from mental illnesses and accompanying distorted thinking (resulting from delusions and hallucinations). Drugs and alcohol, as well as panic and stress resulting from disruptions during the execution of the crime, are factors which must be considered in the overall assessment of the crime scene.

*Crime Scene Dynamics*

Crime scene dynamics are the numerous elements common to every crime scene which must be interpreted by investigating officers and are at times easily misunderstood. Examples include location of crime scene, cause of death, method of killing, positioning of body, excessive trauma, and location of wounds.

The investigative profiler reads the dynamics of a crime scene and interprets them based on his experience with similar cases where the outcome is known. Extensive research by the Behavioral Science Unit at the FBI Academy and in-depth interviews with incarcerated felons who have committed such crimes have provided a vast body of knowledge of common threads that link crime scene dynamics to specific criminal personality patterns. For example, a common error of some police investigators is to assess a particularly brutal lust-mutilation murder as the work of a sex fiend and to direct the investigation toward known sex offenders when such crimes are commonly perpetrated by youthful individuals with no criminal record.

## 4. Criminal Profile Stage

The fourth stage in generating a criminal profile deals with the type of person who committed the crime and that individual's behavioral organization with relation to the crime. Once this description is generated, the strategy of investigation can be formulated, as this strategy requires a basic understanding of how an individual will respond to a variety of investigative efforts.

Included in the criminal profile are background information (demographics),

physical characteristics, habits, beliefs and values, pre-offense behavior leading to the crime, and post-offense behavior. It may also include investigative recommendations for interrogating or interviewing, identifying, and apprehending the offender.

This fourth stage has an important means of validating the criminal profile—Feedback No. 1. The profile must fit with the earlier reconstruction of the crime, with the evidence, and with the key decision process models. In addition, the investigative procedure developed from the recommendations must make sense in terms of the expected response patterns of the offender. If there is a lack of congruence, the investigative profilers review all available data. As Hercule Poirot observed, "To know is to have all of the evidence and facts fit into place."

### 5. Investigation Stage

Once the congruence of the criminal profile is determined, a written report is provided to the requesting agency and added to its ongoing investigative efforts. The investigative recommendations generated in Stage 4 are applied, and suspects matching the profile are evaluated. If identification, apprehension, and a confession result, the goal of the profile effort has been met. If new evidence is generated (e.g., by another murder) and/or there is no identification of a suspect, reevaluation occurs via Feedback No. 2. The information is reexamined and the profile revalidated.

### 6. Apprehension Stage

Once a suspect is apprehended, the agreement between the outcome and the various stages in the profile-generating-process are examined. When an apprehended suspect admits guilt, it is important to conduct a detailed interview to check the total profiling process for validity.

## CASE EXAMPLE

A young woman's nude body was discovered at 3:00 p.m. on the roof landing of the apartment building where she lived. She had been badly beaten about the face and strangled with the strap of her purse. Her nipples had been cut off after death and placed on her chest. Scrawled in ink on the inside of her thigh was, "You can't stop me." The words "Fuck you" were scrawled on her abdomen. A pendant in the form of a Jewish sign (Chai), which she usually wore as a good luck piece around her neck, was missing and presumed taken by the murderer. Her underpants had been pulled over her face; her nylons were removed and very loosely tied around her wrists and ankles near a railing. The murderer had placed symmetrically on either side of the victim's head the pierced earrings she had been wearing. An umbrella and inkpen had been forced into the vagina and a hair comb was placed in her pubic hair. The woman's jaw and nose had been broken and her molars loosened. She suffered multiple face fractures caused by a blunt force. Cause of death was asphyxia by ligature (pocketbook strap)

strangulation. There were post-mortem bite marks on the victim's thighs, as well as contusions, hemorrhages, and lacerations to the body. The killer also defecated on the roof landing and covered it with the victim's clothing.

The following discussion of this case in the context of the six stages of the criminal-profile-generating process illustrates how this process works.

## Profiling Inputs

In terms of *crime scene evidence*, everything the offender used at the crime scene belonged to the victim. Even the comb and the felt-tip pen used to write on her body came from her purse. The offender apparently did not plan this crime; he had no gun, ropes, or tape for the victim's mouth. He probably did not even plan to encounter her that morning at that location. The crime scene indicated a spontaneous event; in other words, the killer did not stalk or wait for the victim. The crime scene differs from the death scene. The initial abduction was on the stairwell; then the victim was taken to a more remote area.

Investigation of the *victim* revealed that the 26-year-old, 90-pound, 4'11" white female awoke around 6:30 a.m. She dressed, had a breakfast of coffee and juice, and left her apartment for work at a nearby day care center, where she was employed as a group teacher for handicapped children. She resided with her mother and father. When she would leave for work in the morning, she would take the elevator or walk down the stairs, depending on her mood. The victim was a quiet young woman who had a slight curvature of the spine (kyhoscoliosis).

The *forensic information* in the medical examiner's report was important in determining the extent of the wounds, as well as how the victim was assaulted and whether evidence of sexual assault was present or absent. No semen was noted in the vagina, but semen was found on the body. It appeared that the murderer stood directly over the victim and masturbated. There were visible bite marks on the victim's thighs and knee area. He cut off her nipples with a knife after she was dead and wrote on the body. Cause of death was strangulation, first manual, then ligature, with the strap of her purse. The fact that the murderer used a weapon of opportunity indicates that he did not prepare to commit this crime. He probably used his fist to render her unconscious, which may be the reason no one heard any screams. There were no deep stab wounds and the knife used to mutilate the victim's breast apparently was not big, probably a penknife that the offender normally carried. The killer used the victim's belts to tie her right arm and right leg, but he apparently untied them in order to position the body before he left.

The *preliminary police report* revealed that another resident of the apartment building, a white male, aged 15, discovered the victim's wallet in a stairwell between the third and fourth floors at approximately 8:20 a.m. He retained the wallet until he returned home from school for lunch that afternoon. At that time, he gave the wallet to his father, a white male, aged 40. The father went to the victim's apartment at 2:50 p.m. and gave the wallet to the victim's mother.

When the mother called the day care center to inform her daughter about the

wallet, she learned that her daughter had not appeared for work that morning. The mother, the victim's sister, and a neighbor began a search of the building and discovered the body. The neighbor called the police. Police at the scene found no witnesses who saw the victim after she left her apartment that morning.

## Decision Process

This crime's *style* is a single homicide with the murderer's primary intent making it a sexually motivated *type* of crime. There was a degree of *planning* indicated by the organization and sophistication of the crime scene. The idea of murder had probably occupied the killer for a long period of time. The sexual fantasies may have started through the use and collecting of sadistic pornography depicting torture and violent sexual acts.

*Victim risk* assessment revealed that the victim was known to be very self-conscious about her physical handicap and size and she was a plain-looking woman who did not date. She led a reclusive life and was not the type of victim that would or could fight an assailant or scream and yell. She would be easily dominated and controlled, particularly in view of her small stature.

Based upon the information on occupation and lifestyle, we have a low-risk victim living in an area that was at low risk for violent crimes. The apartment building was part of a 23-building public housing project in which the racial mixture of residents was 50% black, 40% white, and 10% Hispanic. It was located in the confines of a major police precinct. There had been no other similar crimes reported in the victim's or nearby complexes.

The crime was considered very *high risk* for the offender. He committed the crime in broad daylight, and there was a possibility that other people who were up early might see him. There was no set pattern of the victim taking the stairway or the elevator. It appeared that the victim happened to cross the path of the offender.

There was no *escalation* factor present in this crime scene. The *time* for the crime was considerable. The amount of time the murderer spent with his victim increased his risk of being apprehended. All his activities with the victim—removing her earrings, cutting off her nipples, masturbating over her—took a substantial amount of time.

The *location* of the crime suggested that the offender felt comfortable in the area. He had been here before, and he felt that no one would interrupt the murder.

## Crime Assessment

The crime scene indicated the murder was one event, not one of a series of events. It also appeared to be a first-time killing, and the subject was not a typical organized offender. There were elements of both disorganization and organization; the offender might fall into a mixed category.

A reconstruction of the crime/death scene provides an overall picture of the

crime. To begin with, the victim was not necessarily stalked but instead confronted. What was her reaction? Did she recognize her assailant, fight him off, or try to get away? The subject had to kill her to carry out his sexually violent fantasies. The murderer was on known territory and thus had a reason to be there at 6:30 in the morning: either he resided there or he was employed at this particular complex.

The killer's control of the victim was through the use of blunt force trauma, with the blow to her face the first indication of his intention. It is probable the victim was selected because she posed little or no threat to the offender. Because she didn't fight, run, or scream, it appears that she did not perceive her abductor as a threat. Either she knew him, had seen him before, or he looked nonthreatening (i.e., he was dressed as a janitor, a postman, or businessman) and therefore his presence in the apartment would not alarm his victim.

In the sequence of the crime, the killer first rendered the victim unconscious and possibly dead; he could easily pick her up because of her small size. He took her up to the roof landing and had time to manipulate her body while she was unconscious. He positioned the body, undressed her, acted out certain fantasies which led to masturbation. The killer took his time at the scene, and he probably knew that no one would come to the roof and disturb him in the early morning since he was familiar with the area and had been there many times in the past.

The crime scene was not staged. Sadistic ritualistic fantasy generated the sexual motivation for murder. The murderer displayed total domination of the victim. In addition, he placed the victim in a degrading posture, which reflected his lack of remorse about the killing.

The crime scene dynamics of the covering of the killer's feces and his positioning of the body are incongruent and need to be interpreted. First, as previously described, the crime was opportunistic. The crime scene portrayed the intricacies of a long-standing murderous fantasy. Once the killer had a victim, he had a set plan about killing and abusing the body. However, within the context of the crime, the profilers note a paradox: the covered feces. Defecation was not part of the ritual fantasy and thus it was covered. The presence of the feces also supports the length of time taken for the crime, the control the murderer had over the victim (her unconscious state), and the knowledge he would not be interrupted.

The positioning of the victim suggested the offender was acting out something he had seen before, perhaps in a fantasy or in a sado-masochistic pornographic magazine. Because the victim was unconscious, the killer did not need to tie her hands. Yet he continued to tie her neck and strangle her. He positioned her earrings in a ritualistic manner, and he wrote on her body. This reflects some sort of imagery that he probably had repeated over and over in his mind. He took her necklace as a souvenir; perhaps to carry around in his pocket. The investigative profilers noted that the body was positioned in the form of the woman's missing Jewish symbol.

## Criminal Profile

Based on the information derived during the previous stages, a criminal profile of the murderer was generated. First, a physical description of the suspect stated that he would be a white male, between 25 and 35, or the same general age as the victim, and of average appearance. The murderer would not look out of context in the area. He would be of average intelligence and would be a high-school or college dropout. He would not have a military history and may be unemployed. His occupation would be blue-collar or skilled. Alcohol or drugs did not assume a major role, as the crime occurred in the early morning.

The suspect would have difficulty maintaining any kind of personal relationships with women. If he dated, he would date women younger than himself, as he would have to be able to dominate and control in the relationships.

He would be sexually inexperienced, sexually inadequate, and never married. He would have a pornography collection. The subject would have sadistic tendencies; the umbrella and the masturbation act are clearly acts of sexual substitution. The sexual acts showed controlled aggression, but rage or hatred of women was obviously present. The murderer was not reacting to rejection from women as much as to morbid curiosity.

In addressing the habits of the murderer, the profile revealed there would be a reason for the killer to be at the crime scene at 6:30 in the morning. He could be employed in the apartment complex, be in the complex on business, or reside in the complex.

Although the offender might have preferred his victim conscious, he had to render her unconscious because he did not want to get caught. He did not want the woman screaming for help.

The murderer's infliction of sexual, sadistic acts on an inanimate body suggests he was disorganized. He probably would be a very confused person, possibly with previous mental problems. If he had carried out such acts on a living victim, he would have a different type of personality. The fact that he inflicted acts on a dead or unconscious person indicated his inability to function with a live or conscious person.

The crime scene reflected that the killer felt justified in his actions and that he felt no remorse. He was not subtle. He left the victim in a provocative, humiliating position, exactly the way he wanted her to be found. He challenged the police in his message written on the victim; the messages also indicated the subject might well kill again.

## Investigation

The crime received intense coverage by the local media because it was such an extraordinary homicide. The local police responded to a radio call of a homicide. They in turn notified the detective bureau, which notified the forensic crime scene unit, medical examiner's office, and the county district attorney's

office. A task force was immediately assembled of approximately 26 detectives and supervisors.

An intensive investigation resulted, which included speaking to, and interviewing, over 2,000 people. Records checks of known sex offenders in the area proved fruitless. Hand writing samples were taken of possible suspects to compare with the writing on the body. Mental hospitals in the area were checked for people who might fit the profile of this type killer.

The FBI's Behavioral Science Unit was contacted to compile a profile. In the profile, the investigation recommendation included that the offender knew that the police sooner or later would contact him because he either worked or lived in the building. The killer would somehow inject himself into the investigation, and although he might appear cooperative to the extreme, he would really be seeking information. In addition, he might try to contact the victim's family.

## Apprehension

The outcome of the investigation was apprehension of a suspect 13 months following the discovery of the victim's body. After receiving the criminal profile, police reviewed their files of 22 suspects they had interviewed. One man stood out. This suspect's father lived down the hall in the same apartment building as the victim. Police originally had interviewed his father, who told them his son was a patient at the local psychiatric hospital. Police learned later that the son had been absent without permission from the hospital the day and evening prior to the murder.

They also learned he was an unemployed actor who lived alone; his mother had died of a stroke when he was 19 years old (11 years previous). He had had academic problems of repeating a grade and dropped out of school. He was a white, 30-year-old, never-married male who was an only child. His father was a blue-collar worker who also was an ex-prize fighter. The suspect reportedly had his arm in a cast at the time of the crime. A search of his room revealed a pornography collection. He had never been in the military, had no girlfriends, and was described as being insecure with women. The man suffered from depression and was receiving psychiatric treatment and hospitalization. He had a history of repeated suicidal attempts (hanging/asphyxiation) both before and after the offense.

The suspect was tried, found guilty, and is serving a sentence from 25 years to life for this mutilation murder. He denies committing the murder and states he did not know the victim. Police proved that security was lax at the psychiatric hospital in which the suspect was confined and that he could literally come and go as he pleased. However, the most conclusive evidence against him at his trial were his teeth impressions. Three separate forensic dentists, prominent in their field, conducted independent tests and all agreed that the suspect's teeth impressions matched the bite marks found on the victim's body.

## CONCLUSION

Criminal personality profiling has proven to be a useful tool to law enforcement in solving violent, apparently motiveless crimes. The process has aided significantly in the solution of many cases over the past decade. It is believed that through the research efforts of personnel in the FBI's National Center for the Analysis of Violent Crime and professionals in other field, the profiling process will continue to be refined and be a viable investigative aid to law enforcement.

## REFERENCES


Brussel, J. S. (1968). *Casebook of a crime psychiatrist*. New York: Grove.

Casey-Owens, M. (1984). The anonymous letter-writer—a psychological profile? *Journal of Forensic Sciences*, 29, 816–819.

Christie, A. (1963). *The clocks* (pp. 227–228). New York: Pocket Books.

Geberth, V. J. (1981, September). Psychological profiling. *Law and Order*, pp. 46–49.

Hazelwood, R. R. (1983, September). The behavior-oriented interview of rape victims: The key to profiling. *FBI Law Enforcement Bulletin*, pp. 1–8.

Hazlewood, R. R. & Douglas, J. E. (1980, April). The lust murderer. *FBI Law Enforcement Bulletin*.

Lunde, D. T. (1976). *Murder and madness*. San Francisco, CA: San Francisco Book Co.

Miron, M. S., & Douglas, J. E. (1979, September). Threat analysis: The psycholinguistic approach. *FBI Law Enforcement Bulletin*, pp. 5–9.

Palmer, S. (1960). *A Study of murder*. New York: Thomas Crowell.

Reiser, M. (1982, March). Crime-specific psychological consultation. *The Police Chief*, pp. 53–56.

Ressler, R. K., Burgess, A. W., Douglas, J. E., & Depue, R. L. (1985). Criminal profiling research on homicide. In A. W. Burgess (Ed.), *Rape and sexual assault: A research handbook* (pp. 343–349). New York: Garland.

Rider, A. O. (1980, June). The firesetter: A psychological profile, part 1. *FBI Law Enforcement Bulletin*, pp. 6–13.

Rizzo, N. D. (1982). Murder in Boston: Killers and their victims. *International Journal of Offender Therapy and Comparative Criminology*, *26*(1), 36–42.

Rossi, D. (1982, January). Crime scene behavioral analysis: Another tool for the law enforcement investigator. Official proceedings of the 88th Annual IACP Conference, *The Police Chief*, pp. 152–155.

Vorpagel, R. E. (1982, January). Painting psychological profiles: Charlatanism, charisma, or a new science? Official proceedings of the 88th Annual IACP Conference, *The Police Chief*, pp. 156–159.

DISORGANIZED CRIME SCENE:

1. Location

   - Victim killed and left at scene
   - No effort to hide body - isolated scene
   - Scene proximity to offenders residence/place of employment

2. Weapon

   - One of opportunity - found at scene - (shoe laces on him)
   - Left at scene
   - Death by strangulation or physical trauma
   - Postmortem mutilation with knife

3. Souvenir

   - Normally an object or article of clothes
   - Taken to remember (fantasy)
   - Return to scene/grave

4. Uncontrolled Stabbing or Slashing

5. Bite Marks - breast, buttocks, neck, thighs (post-mortem/frenzied)

6. Dissection of Body - exploratory examination after death

7. Blood smearing - on self, victim

8. Anthropophagy

   - cannibalism
   - vampirism

9. Insertion of foreign objects (Instrumentation - curiosity)

   - anus
   - probing
   - no penis penetration

10. Leaves physical evidence

11. Ritualism

   - crime follows fantasy
   - body or items left symbolic

CHARACTERISTICS - DISORGANIZED TYPE

1. Societal aversion
2. Feels rejected and lonely
3. Difficult interpersonal relationships

4. Lacks cunning
5. Frenzy attack
6. Kills close to home (security)
7. Strange in appearance and behavior

## DEVELOPMENT OF DISORGANIZED TYPE

1. Internalizes hurt, anger and fear
2. Becomes secluded and isolated (withdrawal)
3. Rejects society which he feels has rejected him
4. Poor self-image - inadequacies. Physical ailments or disability
5. Underachiever
6. Substitute sex (voyeurism, panty theft, fantasy, drawings and writings)
7. Described as nice guy, quiet, shy, cooperative
8. Masochistic behavior
9. Crime anti-weak and helpless (young/very old/annals)
10. Arson - nuisance-type

## PROFILE CHARACTERISTICS OF ORGANIZED AND DISORGANIZED MURDERERS

| ORGANIZED | DISORGANIZED |
|---|---|
| Good intelligence | Average intelligence |
| Socially competent | Socially immature |
| Skilled work preferred | Poor work history |
| Sexually competent | Sexually incompetent |
| High birth order | Minimal birth order status |
| Father's work stable | Father's work unstable |
| Inconsistent childhood discipline | Inconsistent childhood discipline |
| Angry depressed mood before crime | Confused frightened mood |
| Controlled mood during crime | Anxious |
| Use of alcohol with crime | Minimal use |
| Precipitating situational stress | Chronic cognitive distress |
| Living with partner | Living alone |
| Mobility with automobile. Auto in good condition | Lives/works near scene |
| Follows crime in media | Minimal interest in media |
| May change jobs or leave town | Minimal change in life-style or behavior |

# PHASES OF A MURDER

## PHASE I

### ANTECEDENT BEHAVIOR

A. Conscious fantasy, plan or purpose of killing

B. Environmental cue that activates fantasy

## PHASE II

### THE MURDER ACT

A. Selecting the victim

B. Method and manner of the killing

## PHASE III

### Disposing of the body

A. Transport or leave at scene

B. Concealment or open display

## PHASE IV

### Post-offense behavior

1. Fantasy becomes reality
2. Maintain fantasy through continued killing
3. Get involved in investigation
4. Stay or leave area of crime
   Attend wake, funeral, etc.
5. Visit gravesite, murder site or other significant locations

## CRIME SCENE DIFFERENCE BETWEEN ORGANIZED AND DISORGANIZED MURDERS

| ORGANIZED | DISORGANIZED |
|---|---|
| Transports victim in assault and disposal | Assaults and disposal at same site |
| Weapon brought to and taken from scene ("murder kit") | Weapon of opportunity |
| Assault reflects controlled rage | Uncontrolled rage |
| Sexual experimentation | Postmortem experimentation |
| Body positioned to degrade | For symbolic purposes |
| Crime occurs at any and all times | Crime nocturnal or in accord with subject's daily schedule |
| Crime scene reflects controlled rage | Crime scene random and sloppy |
| Little evidence left at scene | Considerable evidence |
| Offense premeditated | Spontaneous |
| Victim of opportunity unknown | Victim may be unknown |
| Crime scene location varies | Crime scene is clustered |
| Subject hunts victim | Selects victims randomly |
| Victim's body concealed | Minimal attempt to conceal |

NOTES

## NOTES

* * * * *

# Overview of Drowning

* * * * *

AN OVERVIEW

OF

DROWNING

Arthur E. Westveer
FBI Academy
Quantico, Virginia

Drowning

The result of submersion or partial submersion or immersion in a fluid.

Mechanism

Recently the mechanism of drowning has been recognized as something more complex than simple mechanical obstruction of the air passages by fluid.

The inhalation of water can and does result in its absorption by the circulating blood, the changes caused by this absorption contribute materially to death by drowning.

The victim must have inhaled enough fluid and survived long enough for a' sorption and electrolyte exchange to take place. This can occur within a few minutes following total submersion.

Signs of Drowning

There are consistent signs peculiar to drowning. The special difficulty in interpretation is to distinguish between accidental, suicidal and homicidal drowning. For this reason it is imperative that all available information be given to the pathologist prior to autopsy.

External Signs of Drowning

Cooling in water occurs at about twice the rate of cooling in air, most bodies are cool or cold when recovered. Body temperature falls at a rate of 5 degrees per hour. The body will reach the temperature of its surroundings in five or six hours; always within 12 hours of submersion. Exposure and oxygenation will frequently cause the head, neck and front of the chest to turn a bright pink color.

Putrefaction is often present and the skin may be green of bronze in color, or it may be exceptionally dark. The presence of foam (pulmonary edema) at the mouth or nostrils, or both, is an important, although in no way a conclusive sign of drowning. Pulmonary edema is caused by strangulation or epileptic seizure. Putrefaction will destroy foam. This foam is caused when fluid enters the air passages and provokes them to form mucus which when mixed with air forms a foam from the violent respiratory efforts of the victim.

A bruised or bitten tongue may indicate that the victim struggled or had an epileptic seizure. Instantaneous rigor, always uncommon, is sometimes a result of submersion. Weeds or sand may be held in the hands or feet, evidence that there was life at the time of submersion.

It is necessary to distinguish between changes due to drowning and those which are solely the result of submersion in water.

Inhalation of a thick suspension of sand in sea water. This may occur while bathing in shallow water when knocked down by a large wave or hitting the abdomen with a surf board. Death occurs with appalling suddenness.

Chemicals in water may not contribute to the cause of death, but their detention in the body of the victim can confirm the fact of drowning in that fluid.

Internal Signs of Drowning

Putrefaction will abolish the internal signs of drowning. Foam is present, in varying amounts, in the air passages. They may be completely filled or just partially. Water will also be present in the air passages. This may be abundant and escape from the mouth when the body is turned.

The Larynx may be congested. The lungs will be bulky or ballooned, often to the degree of overlapping the pericardium. There may be rib marking on the lungs.

Obstruction of the pulmonary circulation, due to the inhalation of water, results in distention of the right heart and great veins, which are filled with dark red blood. The blood also is likely to remain fluid and free from clots. Dilution of the blood by inhaled water is responsible for the prevention of coagulation. The blood often has a watery consistency and does not tend to adhere to the hands.

The Time it Takes to Drown

Varies within somewhat wide limits

1. Circumstances of submersion

2. Kind of victim

3. Reactions to submersion

4. Volume of water inhaled

Time reduced when submersion is unexpected and when the victim is out of shape or unable to swim.

Death may be immediate when due to cardiac inhibition. Those who panic will succumb more quickly than those who try to remain calm. Cramps and other injuries sustained at the time of submersion will also play a part.

Sudden submersion into cold water can cause death from cardiac failure. This is brought about when the uncontrollable respiratory distress during cold immersion may cause the victim to inhale water.

Ordinarily, unconsciousness, if not death, ensues within two or three to ten minutes after submersion. Before death there may be a period of suspended animation during which it is still possible to resuscitate the victim. This is possible even if the victim has been submerged for as long as 30 minutes.

The popular belief that a person sinks and rises three times before drowning is a misconception. There is wide variation in the number of times he may sink before remaining submerged.

There is usually a brief convulsive phase, followed by coma or suspended animation and death.

The body eventually sinks and remains on the bottom, until putrefaction sets in causing the formation of gas which causes the body to float. This occurs in 7 to 14 days.

Fresh Water

When inhaled in quantity causes rapid and considerable dilution of the blood.

Salt Water

When inhaled in quantity causes haemoconcentration and grave disturbance of the electrolyte balance.

Exception abrupt cardiac arrest due to vagal inhibition or laryngeal spasm.

## BODIES RECOVERED FROM WATER

Along the sea, along lakes and rivers, bodies recovered from water are frequently submitted for forensic examination, which aims at identification, determination of cause and manner, time, and location of death, and preservation of evidence. The examination of bodies recovered from water, while to a great extent a routine medico-legal procedure, best supported by extensive use of photographic documentation, poses particular problems. These are sometimes difficult or impossible to solve, and often involve special methods.

The causes and mechanisms of death in water are manifold and may overlap. Drowning, which is to suffer death from submersion or immersion, includes various processes, but does not cover traumatic or natural death in water. If immersion is entering water, and submersion is arbitrarily defined as having at least mouth and nose under water, death by drowning can be classified as follows:

A. Death due to submersion

1. with massive aspiration of fluid
2. with little or no aspiration of fluid

B. Death due to immersion

Death from submersion due to suffocation from inhaling water, or other fluids into the air passages and lungs, is generally accompanied by struggle for survival if the victim is conscious. Death from immersion, due to reflex mechanisms and shock, generally occurs without struggle. Death is caused by shock from cold, pain, or fright, or is due to circulatory collapse. Suffocation from aspiration of water may supervene. The boundaries between these two entities are not always distinct.

Death in water can be caused by mechanical trauma unrelated to drowning. It may be due to the impact of a fall from great height, to the action of powerful waves causing neck fracture, to blows of floating objects in waves, or fixed under-water objects like tree trunks, striking the solar plexus. Contact with propellers of ships produces serious traumatic injuries usually fatal.

Natural sudden death, as from coronary occlusion and other causes, may happen in water as on land. Sudden attacks of pain, vomiting or other violent symptoms of diseases lead to aspiration of water and secondarily to drowning.

The process of drowning due to aspiration of water proceeds through well-recognized stages.

1. Due to cold and surprise - but often absent if water is entered voluntarily - a deep initial inspiration may be taken.

2. The initial response to sinking is a voluntary apnea with violent struggling lasting generally ½ to 1 minute. This results in carbon dioxide accumulation.

3. Carbon dioxide acts on the respiratory center. A deep breath is taken, water is freely inhaled into the lungs, or may cause glottic spasm. Inspiratory dyspnea is followed by expiratory dyspnea with violent, forced expiration and cough. Formation of persistent, fine, obstructive froth results from churning, especially in distal air spaces, of the mixture of air, water and mucus with the fluid of rapidly appearing pulmonary edema. Experiments using deuterium oxide as a tracer have shown that water both leaves and enters the circulation. Obstructive emphysema due to the foam ensues with tearing of alveolar walls leading to the characteristic aqueous emphysema and to Tardieu's spots.

4. Loss of consciousness and convulsive spasms with deep breathing, and further aspiration of water follows, lasting for 1 to 1½ minutes.

5. Paralysis of the respiratory center leads to pre-terminal apnea. Convulsion changes to muscular twitchings.

6. Terminal fish-like snapping gasps due to action of chemo-receptor organs in absence of acting respiratory centers repeat themselves at intervals and precede death.

In fresh water this sequence lasts about 3 to 5 minutes. During expiratory dyspnea the systolic arterial pressure collapses followed by fading of the diastolic pressure. In the majority of cases ventricular fibrillation occurs within a few seconds of the collapse of the blood pressure. Fresh water rapidly enters the pulmonary circulation. Diluted, hemolyzed blood reaches the left ventricle. Reduction of sodium chloride and myocardial anoxia occurs. Ventricular fibrillation is apt to develop and depends, as observed in dogs, on the degree of hemolysis. Death is mainly due to hemodilution except in cases of glottic spasm which causes anoxic death.

Sea water drownings are slower, extending over 8 to 10 minutes. Less froth is formed. Water is withdrawn from the pulmonary circulation into the alveoli due to the prevailing higher osmotic pressure of the sea water, whose electrolytes enter the blood. Hemoconcentration results instead of dilution and hemolysis is absent. Ventricular fibrillation does not occur as shown in animals. Pulse pressure decreases slowly with gradual fall in the diastolic level. The heart functions with gradually diminishing efficiency. Auricular and ventricular rhythm become dissociated. In dogs cardiac arrest occurs after about 9 minutes. The slowness of the process and the absence of fibrillation readily explain the better results of resuscitation in salt water drowning.

Factors which either cause or contribute to accidental drowning are not only important for a better understanding of but also for the prevention of accidents. Inability to swim is a self-evident danger. Poor swimmers, on finding themselves in deep water, or, on stepping into deep holes, are often overcome by fear. Even good swimmers are often not sufficiently familiar with handling the natural vicissitudes of water. They try to fight currents instead of swimming with them, slowly working back to the shore. Outgoing rip tides can be crossed to the point where the water flows back to the shore. Undertows are dangerous when standing in the water, not when swimming on top. Powerful breakers can be avoided by diving through them. Exhaustion from swimming too

rapidly or too far becomes more dangerous if adverse currents or surf are met. A full stomach may lead to vomiting on exertion and thereby easily lead to panic and to aspiration of both vomitus and water. A full stomach also causes high position of the diaphragm and increases the cardiac and respiratory load, especially in the presence of a hypoplastic heart or aorta, coronary sclerosis and other pathologic conditions. Perforation of an eardrum, pre-existing or from diving, allows cold water to enter the middle ear and may cause nausea, vomiting, vertigo, and unconsciousness.

Sudden severe pain due to muscle cramps, gall stones or kidney stones, or injury resulting in a tear of an eyelid, or a blow to the solar plexus may lead to loss of control in water. Fright alone is able to kill.

Deaths from drowning due to causes other than aspiration of water do not lead to characteristic autopsy findings, and are less well understood. They are probably due to reflex action, circulatory collapse or both. People sink suddenly while swimming, or fall while standing in water. In other cases the immersion is sudden or unexpected, as in walking off the edge of a dock, being suddenly pushed into cold water or falling into it, and the victim sinks without struggle.

A number of mechanisms are suspected in these deaths: Glottic spasm due to the local impact of cold water and to sudden chilling of neck and chest. Asphyxia may occur before signs of drowning develop, or are fully developed.

"Laryngeal shock" from impingement of cold water on nasal and the postnasal mucous membranes may lead to death from cardiac arrest due to glosso-pharyngeal and vagal stimulation. Circulatory collapse due to cold or exertion may lead to loss of consciousness and sinking before carbon dioxide can reach the respiratory center. Fear and surprise may lead to cardiac standstill. Physical allergy to cold itself is known to produce urticaria in bathers and swimmers and has been considered as a possible cause of death. Such skin changes would rapidly disappear after death and might not be seen at autopsy.

Sea animals can become the cause both of death, and of postmortem injuries (see later). Attacks of sharks have a fatality rate of 50% to 80%, due to hemorrhage and shock. Severe abrasions may be due to brushing against their skin. Barracuda bites can be distinguished from those of sharks, since the former cause straight cuts while bites of sharks are curved like the shape of their jaws. The ferocious piranhas of the Amazon are able to skeletonize a human within minutes. Weever fishes (Trachini) and scorpion fishes (Scorpenidae) are poisonous and both species have been reported to cause death. Wounds appear first blanched, but soon become reddened and swollen. Vomiting occurs. The sting-rays cause lacerations or puncture wounds with swelling, initially ashen grey, they become cyanotic and later red. These injuries most often occur on foot or ankle from stepping on the fish, but may be found in other areas of the body. The poisonous Moray eels produce wounds of a tearing and ragged character, which result in a death rate of about 10%. Electric eels in the head waters of the Amazon and Orinoco kill by sending out 400 to 600 shocks per second at 600 volts and up to 1 ampere. Portuguese Man-of-War (Physalia physalis) may wander from the Gulfstream into coastal waters of the United States, and may be deadly.

This is also true of the Sea Nettle (Dactylometra quinquecirrha) and the Sea Blubber (Cyanea capillita), both of which are widely distributed species. The Sea Wasp (Chiropsalmus quadrigatus), a poisonous jelly fish living in waters of the Phillipines, Australia, and of the Indian Ocean may produce death in 3 to 8 minutes. Inflammatory rash, ecchymoses, and vomiting are characteristic. Dangerous sea urchins with poisonous pedicellariae occur on the East Asian coast of the Pacific.

Recovery of a body from water does not imply aquatic death. At autopsy no effort should be spared to prove or disprove death before immersion. On the findings depend prosecution for crime, as well as claims for insurance. Disposal of bodies in water after homicide must be kept in mind. Stillborn infants and victims of infanticide are found in toilets, cesspools, rivers and lakes. A fall into the water after sudden death at the edge can easily lead to a false assumption of accidental drowning or suicide.

Relevant facts about the decedent, known circumstances surrounding his death, as well as the recovery of his body should be made available to the forensic pathologist to guide him in his examinations and conclusions. The past history of the decedent's health, such as epileptic fits, or attacks of angina pectoris, can reveal explanatory facts. Knowledge of habits, character, recent activities, and reports on suicidal tendencies are helpful. Letters left on the shore or at home may clearly establish suicide.

Information on resuscitation procedures may explain wounds. The report of attempted artificial respiration is important. Foam in and about the upper air passages can be removed or produced by this procedure. Foreign material may be moved to more distal locations in the respiratory tract.

All objects and materials adherent or embedded in clothing or skin should be retained. A splinter may match the wood of the bridge where the body entered the water.

The result of the investigation of a known locale of immersion, and that of finding the body should be available. Signs of struggle point to homicide, clothes neatly arranged in a pile on the shore to suicide, however, a naked body might have been unclothed by a rapidly moving stream or tide.

An intoxicated or otherwise unconscious person can drown in a puddle, and even bathtubs have proved to be the site of easy murder by pulling the victim's feet.

Water from the place of immersion, and, if unknown, from the place of recovery of the body should always be submitted. It will often reveal principal species of algae and diatoms for comparison with those found in the victim, and will give the sodium chloride content in case of brackish water.

Knowledge of the appearance of the body at the moment of recovery and the knowledge of the hour of recovery can be imperative in judging the time of death, since changes due to decomposition often develop rapidly after removal of the body from water.

Knowledge of the principles guiding sinking and floating of bodies are important, since they may be helpful in estimating the approximate time of entering the water. Sinking and floating depend on the content of air in the lungs, gas in the intestinal tract, and tissues, and on the amount of fat tissue, since these decrease the specific weight. The body may remain floating, but generally it will sink first and come up later when putrefactive gases have formed. Most cadavers float face down, the head lower than the trunk. Gas appears first in these dependent areas. In water of 65° F. the body rises generally after 4 to 8 hours, in winter later or not at all. In Virginia tidewater area floaters appear in April and May. Bodies in fresh water come to the surface later than those in salt water of higher specific gravity. As putrefaction continues, gases escape, bloating disappears and the body may sink again. The deeper a body sinks the less buoyant it becomes from compression of gases. Bodies sinking in water of very great depth never rise. Rocks and other obstructions and a slow rate of flow at the bottom of rivers impede the movement of bodies which will rise a few hundred yards from the site of immersion. In a fast moving river with smooth bottom and in large lakes they might be found thirty and more miles away.

Weights attached to the body are found both after suicide and homicide, and occasionally in disposal of a cadaver, such as that of a stillbirth. Decomposing bodies can lift very heavy weights, up to 150 pounds and more having been reported. The manner of attachment of the weights must be studied most carefully to distinguish self-attached objects from those bound to the body by the hands of others. Persons committing suicide may wish to mislead a later investigator, either to dramatize their death or to remove proof of their suicidal intent.

Accurate description is imperative for identification. It includes livores, rigor mortis, signs of decomposition, sex, race, estimated age, height, and weight. Circumcision, the presence of scars of operations or trauma are noted and size and location given. Dental charts are best prepared by a dental consultant. Artificial dentures may have decedents name embedded in the plastic. In unidentified bodies tattoos, common among dwellers along the shores, should be photographed or preserved. Experts are often able to diagnose countries, or even the ports where they were acquired. In bodies recovered from the water baldness may be due to loss of hair after death. Then the openings of the hair follicles will be present. Eye color may change from other colors to brown before the cornea becomes cloudy.

Finger-printing of bodies found in water may require special methods. Photographs through glass plates pressed against fingers and the hands are helpful. The phalangeal skin may be dissected and, with the use of the investigator's finger, may be rolled for prints. Filling the pulp with glycerine, oil or melted paraffin can be helpful in obtaining prints. If no fingerprint expert is available during the examination of the body, the hands may be removed and sent to him in moist cotton.

An itemized list of clothing and articles found in the pockets should be preserved. Size, brand names, vendor's labels, laundry marks, and other descriptive and identifying features are recorded. Cigarette packages, especially their water resistant foil, assist by their serial markings in determining the approximate time of immersion or death, as well as the place where the package was bought.

TABLE II

Approximate Time of Appearance of Signs of Decomposition

| | Summer | Winter |
|---|---|---|
| Face and neck, bluish or blue-red | 4-8 hours | Longer |
| Face and neck, dirty green | 3-5 weeks | 2-3 months |
| Body highly swollen, features unrecognizable, head green-black, no skin left. | 5-6 weeks | More than 11 weeks |

A peculiar change seen occasionally in water of high calcium content is white nodules which appear on the skin and inner organs, and are caused by putrefactive phosphoric acid which forms calcium phosphate.

The formation of adipocere, or fat wax, is another decompositional change helpful in judging the time of immersion, and, sometimes in preservation of characteristic findings. Adipocere, a fatty, greyish or yellowish-white substance, imparts a granular appearance to the body surface, which is that of the subcutaneous fat tissue after disappearance of the skin. Of pasty consistency early, adipocere becomes firmer with time. It has an unctuous feeling and a moldy, cheesy odor. It melts in heat, and burns with a feebly luminous flame. The formation of adipocere seen in bodies subjected to high moisture is attributed to bacterial enzymatic action. Found mainly in bodies recovered from water, it is occasionally, but to a lesser degree, observed in those found in very humid, sunless spots, or in moist ground, especially clay.

The three basic conditions promoting the formation of adipocere are presence of water, lack of oxygen, and warm temperature. The process advances more rapidly in streaming, warm water, close to sewage outlets, and in the small bodies of children. Adiposity seems a promoting factor. The waxy material forms slowly, progressing from the outside to the inside of the body. In an exceptional case of a baby it has been observed after two weeks. Table III shows the time of its appearance in various areas of the body.

TABLE III

Appearance of Adipocere

| | |
|---|---|
| First appearance in subcutaneous tissue | 1-2 months |
| Extensive involvement of subcutaneous tissue | 2-4 months |
| First appearance in muscles | more than 3 months |
| Muscles of face | more than 6 months |
| Deep muscles | more than 12 months |
| Whole body | several years. |

The distribution over the body surface is often unequal; some areas may show fat wax, while others are skeletonized. The organs may change into fatty masses or may retain their former shape. Stab wounds, strangulation marks and similar changes may be easily recognizable after several years. Of the

internal organs the liver is commonly involved, especially if it was fatty. In fatty livers adipocere has been produced experimentally. The chemical changes are not fully understood. Fat under the influence of bacteria becomes rancid, splits into glycerine and free fatty acids. Oleic acid, fluid under usual temperature conditions, and glycerine leave the fat depots, and due to pressure of gas and water move to the inner regions of the body and accumulate in the abdominal cavity. Only the higher fatty acids remain in crystallized form. They partly saponify with calcium and manganese to form a plastic mass which, after drying, becomes firmer. The involvement of non-fatty tissue is by imbibition. Whether or not proteins change to fat is disputed.

Assessment of cutaneous injuries and fractures is of importance. Are these lesions received at or about the time of death, or later, and if so, are they related to the manner of death?

The color of abrasions should be noted. Intravital abrasions tend to be reddish or reddish-brown from blood. Those after death are yellow or brown, and, if dry, emit sound when hit with metal. Tissue from these lesions and all others of traumatic origin should be secured for microscopic examination.

Intravital wounds show retraction and swelling of margins, retraction of muscles, tendons, and arteries. Postmortem trauma produces no staining of edges. They are everted rather than inverted. There may be discoloration beneath the edges.

Fractures that have occurred during life cause hemorrhage, generally massive. They can be sufficiently characteristic to reconstruct events leading to death. Rib fractures may occur in a fall from a bridge. Fall from height is confirmed by finding anemic areas with hyperemic margins at the regions of impact on the water surface. Rupture of liver and spleen occur and may retard the rising of the body. Fractures of the lower legs are common in automobile injuries. Fat and bone marrow embolism are definite proof of fractures during life. Isolated basal skull fractures are intravital and never due to intracranial decompositional gas pressure.

Location, extent, and quantity of hemorrhages must be noted. Relation to hypostasis is of importance. Small hemorrhages and those in areas of hypostasis may have occurred after death. Regional lymph nodes should be checked for blood absorption, which in life will occur within minutes after injuries. Preservation of regional lymph nodes for microscopic examination is important.

X-ray examination in suspicious cases leads to the discovering of bullets otherwise not easily detected in a decomposed body or in bone.

Portmortem injuries may be caused by rocks, shrubbery, tree trunks, spillways, mills, turbines. Propellers of ships can inflict deep gashes, sometimes crescent-shaped, and amputations. Rescue operations, such as dragging or hauling the body aboard, may cause injuries. Pseudo-strangulation marks occur due to swelling of tissue under constricting clothes or necklaces. In shallow water of fast moving rivers and tides, due to the usually prone position of floating bodies, drifting marks are located on the forehead and may destroy the

bone completely though the elastic dura is highly resistant and generally spared. Drifting marks also appear on other dependent portions, which are the nose, back of hands and fingers, back of feet and toes, and knees. If injuries cannot be proven to be intravital, one should attempt to determine the possible responsible agent, which should be compatible with objects that occur in the waters travelled by the cadaver.

Injuries to the dead inflicted by animals are common, and may have specific characteristics. Beaks of birds can produce stab wounds, resembling those from knives. The teeth of young rats produce two round punctures, old animals two slit-like lesions; ulcer-like abrasions are caused by their claws. Water rats, fish, snails, crustaceans such as shrimps, crabs, and lobsters tend to eat the ears, eyelids, and lips, leaving gnawed areas. Sea animals cause extensive destruction of skin and soft tissue. In June, in Long Island Sound, bodies are found skeletonized within two weeks. Starfish cause typical whitish lesions resembling alkaline cauterization. Leeches produce round wounds which extend into the corium. When checking pockets of clothing of bodies recovered from water one should avoid injury to the examining fingers by crabs which may be present.

Maggots of water flies, which tend to attack the ears first, should be carefully observed. Larvae feed only early in life. Their behavior, whether feeding or not, or the presence of the pupae may be helpful in timing the death. Living larvae should be preserved for study of their habits by an experienced entomologist. To give an instance of estimating time from the development of larvae and pupae, the development of the egg of the green bottle fly (Calliphora) is given: Presence of eggs 8 to 14 hours, first larval stage 8 to 14 hours, second larval stage 2 to 3 days, third larval stage 7 to 8 days ( a total of 10 to 12 days); pupal stage 12 days, a total of 22 to 24 days against 14 to 17 days for the housefly. Fleas and lice recovered from bodies may be helpful. Fleas die in water within 24 hours. After 12 hours of immersion their revival takes 1 hour, after 18 to 20 hours the time increases to 4 or 5 hours. Lice die within 12 hours after entering water.

Pigment forming bacteria produce colored spots on the skin. Chromobacterium violaceum grows purple spots and Serratia marcescens (Monas prodigiosa) red ones, which appear after 1 to 2 weeks. If preserved on media and cultured on skin under conditions similar to the exposure of the body, these organisms may assist in timing the duration of immersion. Algae found on the body or clothing may serve the same purpose. A film of green algae on the skin form within 4 days, under clothes within 3 to 10 days. From the second week on a thick layer of algae may be found.

The external examination of the body, besides noting injuries and signs of decomposition previously discussed, can reveal a number of important facts.

The skin color varies. Cyanosis may be present, and point to asphyxia. In many cases, however, the skin is pale due to vascular constriction from cold and shock.

White, adhesive, stiff foam, sometimes blood streaked, exuding from mouth and nostrils, often forms a mushroom-like structure, the "mushroom of drowning". Though seen in pulmonary edema from other causes, this froth, if pronounced, is characteristic of drowning. It may have been washed away by water and reappear with pressure on the chest wall. It is more conspicuous in fresh water deaths. If dried out, it will form a brownish film or crust around mouth and nostrils. Foam may be removed or produced by artificial respiration, but then it is less frothy, and the bubbles are coarser.

The eyes may have a blood-shot appearance. One may find ecchymoses, especially if the eyelids are turned up. In bodies recovered from fresh water the corneae are often remarkably clear.

The eardrums need inspection. If they are not visible by otoscope, the petrous bones should be removed later at autopsy. Rarely, perforation of eardrums may be the cause of drowning. Cold water entering the middle ear can produce nausea, vomiting, and even unconsciousness. Fresh perforations may be due to diving. Old ones show stiff, thickened margins, and can thereby be distinguished from holes caused by decomposition, which have irregular, thin, fading edges.

Typical of drowning, if present, are clenched fists holding, in cadaveric spasm, water-borne objects, like seaweeds, pebbles, sand or soil, which prove that the person was alive at immersion. The preservation of material found under the fingernails can help in deciphering the events leading to death. Bits of hair or cloth may point to violence, and to the assailant.

Vital lacerations of the vulva suggest rape. Bones should be checked for fractures.

The technique of performing the internal examination at autopsy of a body recovered from water varies in certain aspects from the methods followed routinely. The body should be examined as soon as possible to avoid further deterioration. It should be thoroughly cleaned by scrubbing prior to incision and especially in the area of the incision. This will protect the lungs, kidneys, or other organs from contamination with extraneous matter. Algae and diatoms, so useful in proving death by drowning, may otherwise be carried on, or into tissue, later to be investigated for plankton. For the same reason gloves and knives should be changed after the primary incision. The more deteriorated the body the more important these precautions become.

Additional incisions of the subcutaneous tissue, muscles, and later of the intestines, can be made to allow the escape of putrefactive gases. A flaming wad of newspaper held over these cuts will burn gases, and give relief from the disagreeable, sometimes foul odor.

If the body appears well-preserved, blood is taken from the right and left heart for chemical examination at the beginning of the autopsy to prevent movement of blood from the cardiac chambers.

The pleural cavities, as time lapses after death, fill with dirty, blood stained fluid, on which the lungs may later be found floating. Large amounts do not prove, but suggest drowning. The fluid should be measured, and some of it retained for chemical examination.

Before contamination with extraneous matter occurs, flat strips (about 30 gms.) of subpleural lung tissue and one kidney are removed, and are placed in clean containers for plankton examination.

The brain is then removed. This will drain the blood from the neck, and after removal of the skin will allow better visualization of the streaky hemorrhages along the neck muscles, especially the sternocleidomastoids. The pectoral muscles are checked for the same changes. These extravasations, if present, are characteristic of drowning, and are probably due to forced breathing and asphyxia. Spotty hemorrhages about the neck, on the contrary, point to throttling.

Neck organs and lungs are taken out en bloc after ligation or clamping of the main bronchi and mid-trachea. The upper airways are checked in situ. Contents are removed and separately preserved to be studied for water-borne material. A magnifying glass is helpful in discovering small particles. The oropharynx is checked for foreign substances. Esophagus, stomach, and duodenum are clamped with preservation of the pylorus. The contents are later measured and preserved. Contraction or patency of the pylorus is noted.

Before dissecting the separate organs they are examined in situ for traumatic injuries. The heart is checked for communications between right and left side, which will influence the results of chemical tests. After drowning the right heart is generally dilated, the blood is fluid, and in fresh water deaths hemolyzed. Ecchymoses of the epicardium and other serosal surfaces are signs of hypoxia and not of drowning. As a rule they are scarce or absent.

The tongue is checked for scars from epileptic bites. Attention is paid to a fracture of the hyoid bone characteristic of throttling or strangulation. Edema of the glottis and larynx, especially of the false vocal cords, results from soaking in water and is meaningless.

The contents of the air passages are important for the diagnosis of drowning. The significance of water-borne matter increases with its distance from the lips. Water can enter after death, and will be carried down farthest in the small bodies of infants and children found in fast moving water of rivers and tides. If gastric contents be present, they are not always the result of vomiting and aspiration. They may spill to the trachea and even to the lungs due to the movement of the body by the water, or to handling after recovery. The presence of froth and water is characteristic of drowning. Water, however, may be removed by attempted resuscitation which, on the other hand, can produce froth. To prove drowning the amount should be greater than that seen in pulmonary edema from disease.

The classic finding in the lungs of the drowned is aqueous emphysema. On opening the thorax the pale, firm, ballooning organs protrude from the pleural spaces, and overlap in the midline. The ribs have pressed their marks onto the surface. Alveoli become visible due to over-distention and tearing of their walls. Areas of inhaled water mixed with air appear as irregular, subpleural patches of grey-blue to dark-red color, interspersed with the pink, yellowish and grey color of more aerated tissue. Crepitation is felt, and there is pitting on

pressure. On sectioning, the lungs do not collapse. The cut surface is dry, though often with wet spots. Fluid appears on pressure. This "dry edema" and the firmness of the tissue results from imbibition of alveolar walls and septa with water. Pale red areas, Paltauf's spots, may mottle the lung under the pleura and on cut surface. They are of finger-nail size, have indistinct boundaries, and are due to hemorrhages from torn capillaries and hypoxia; their indistinct boundaries and pallor stem from mixing of blood and water and also from hemolysis. They are different from the dark-red, punctate, distinct spots of Tardieu seen in dry asphyxia, and from the larger red areas caused by aspiration of blood. The aqueous emphysema is caused by the initial deep inspiration which increases the air content of the lungs. Air is pressed into the alveoli by aspirated water, and held there by the action of capillary attraction on the mucus and foam in the bronchioli, and by bronchiolar spasm. Aqueous emphysema does not develop if death is due to laryngeal spasm; in the latter instance little or no water enters the lungs. Fibrosis and pleural adhesions reduce ballooning, obliteration of pleural spaces will suppress it. It also is not found if severe chronic emphysema is present. With increasing lapse of time after death the aqueous emphysema disappear. The water seeps from the lungs into the pleural spaces. The lungs assume a collapsed, waterlogged appearance. and may float on the pleural effusion.

The findings in the abdomen vary likewise in their significance. The spleen is more often anemic and contracted. The liver and kidneys are generally congested. Rupture of these organs suggests falling from a height to the water surface.

As mentioned, esophagus, stomach, and duodenum should be clamped at autopsy. Fluid contents are measured, and preserved separately. Filling the stage of digestion of food in stomach and small intestine are noted. These observations are helpful in judging the time of death. The stomach, on the average, is found empty within 4 to 6 hours after eating, the small intestine after 12 hours The time, however, varies greatly, and peristalsis becomes rapid during asphyxia. Determining the type of food can be helpful in reconstruction of the events prior to death.

Water can enter the digestive tract after death, and its significance here increases with its quantity and its distance from the mouth. Visible sand, silt, or marine life distinguishes the medium of submersion from fluids consumed before death, which, like beer, may have a characteristic odor. Water in the duodenum is significant of drowning if the pylorus is closed, and may be found as far down as the ileum due to rapid asphyxiant peristalsis. The collected fluids are centrifuged or strained to remove food, and examined in culture dishes under the binocular microscope for water-borne material, and, with special methods, for plankton. Blood in the stomach is intravital. Occasionally radial tears, fairly characteristic of drowning, are seen at the cardia, probably due to spasm of the diaphragm, high fluid content of the stomach and pressure from vomiting.

The genital organs of women may reveal pertinent facts. Pregnancy may turn a lover into a killer. Pregnancy, puerperium, menstruation and menopause may lead to depressions and self-destruction. Oophorectomy, often performed unnecessarily, may, without substitutional therapy, lead to iatrogenic suicide. The responsible physician should be informed and learn the final outcome of his "case".

The skeleton must not be neglected at autopsy. Isolated basal fractures of the skull are intravital and are never caused by the pressure of putrefactive gases. Fractures of the cervical spine and crushing injuries of the spinal cord from dislocation of vertebrae may, if found, establish the cause of death. All fractures of the spine may lead to drowning. Other fractures of the bones suggest hit and run accidents; the body of the victim may have been disposed of in water.

The histologic examination of organs can assist in solving pertinent questions. As in all autopsies, causes or contributory causes of death, which are not evident at gross examination, may be discovered microscopically. Above all intravital lesions must be distinguished from those after death.

The lungs after drowning show microscopically over-distended air spaces and often rupture of the alveolar walls. In fresh water death the vessels are congested and there is hemolysis of red cells. Salt water causes anemia and crenation of red cells. Amorphous albuminoid material fills the alveoli. Hemorrhages correspond to Paltauf's spots.

Fat and bone marrow embolism, if present, proves the intravital origin of fractures. These as well as wounds and hematomas arose during life if blood is found in the sinusoids of regional lymph nodes, where it may appear within a few minutes after injury. If strands or clots of fibrin are present in hemorrhages, they are generally intravital, though fibrin may still form within six hours after death. Distinct leukocytosis in vessels, marginal position of leukocytes and their diapedesis are always intravital.

The microscopic examination for plankton, green algae and diatoms, whose silicated skeletons resist decomposition, is a most helpful method in the investigation of bodies found in water. These unicellular organisms reach the periphery of the lung only intravitally, except possibly in infants. Moreover, from tears in the alveolar walls, plankton can enter the major circulation, and will be carried to distant organs. Since the kidneys receive more blood per minute than other organs, they will give the highest yield. The hilar area of the liver, and the base of the brain follow next. Finding algae or diatoms in these organs is definite proof of drowning. In gastric or duodenal contents they rule out fluid from drinking, if the pylorus is not yet relaxed as in the later period of deterioration. The presence of plankton beyond the stomach is then definite evidence of drowning.

If one is unfamiliar with the microscopic flora and fauna of the water from which the body was salvaged, samples of the water must be studied prior to the examination of plankton in order to become familiar with its appearance. Polarized light, dark field, or phase microscopy should be used in searching for diatoms. Several methods are available. Search in fluid pressed from strips of peripheral lung tissue, which may first be injected with distilled water, is least time-consuming. The fluid is hemolyzed with 1% acetic acid, and centrifuged. If salt water was aspirated the sediment is washed in distilled water three times. It is dried on a cover glass and embedded in equal parts of bromobenzol and Canada balsam or a similar medium, and then studied. Less desirable, since it is time-consuming, is the examination of numerous unstrained paraffin sections embedded in bromobenzol-Canada balsam, which resembles tissue optically and thereby allows the silicated skeletons of diatoms to stand out distinctly. The highest yield of diatoms, though green algae will be destroyed,

results from chemical ashing of tissue, which should be resorted to if direct examination of fluid was negative. Small pieces of tissue, about 30 gms., or partially evaporated fluid are treated with small amounts of concentrated sulfuric acid under a hood overnight. If too much acid was used, calcium sulfate crystals will form and later interfere with the examination. The next morning the digest is treated with concentrated nitric acid and perhydrol (30% $H_2O_2$). The material is centrifuged after cooling and then examined. The yield is higher if the sediment is not neutralized. Neutralizing it to litmus, however, saves valuable microscopes from exposure to acid fumes.

Green algae disappear with increasing decomposition, but will generally be preserved for two weeks. After eight weeks some may still be identified with difficulty. The finding of diatoms is independent of deterioration. Care must be taken, as mentioned before, not to contaminate organs with plankton.

Chemical examinations for drowning are valuable before the onset of putrefaction. They are based on the absorpiton of water and electrolytes of aspirated fluid into the pulmonary capillaries. Death occurs before an equilibrium between pre and post-pulmonary circulation can be established. Comparison between serum of the left and right side of the heart may show significant chemical and physical differences. Those of sodium chloride content are most commonly used in this country.

In fresh water drowning the blood of the left heart will be diluted by water and the sodium chloride content will be lower than in the right heart. In death from salt water aspiration the sodium chloride content of sea water, five times higher than that of the blood, will lead to the opposite effect. A difference between right and left heart of 35 mg.% (10 mEq/L) is significant; 60 to 80 mg.% (17 to 23 mEq/L) are considered definite proof. Serum magnesium determinations furnish further information. In general, beginning 12 to 24 hours after death, plasma chlorides diminish, while magnesium chlorides rise. In fresh water drowning a drop in chlorides is therefore less significant if the magnesium has risen in both sides of the heart. An increase of magnesium in the left over the right heart in excess of 1.2 mg.% (1 mEq/L) is consistent with drowning in salt water.

Factors which interfere, besides putrefaction, are first glottic spasm, because little or no water reaches the lungs, second septal defects of the heart, such as a patent foramen ovale allowing exchange between the right and left side, and thirdly death in mildly brackish water or bathtub water with salt added, leading to an electrolyte concentration close to that of the blood. It must also be kept in mind that river and fresh water, and sea and salt water, are not always the same. Tidal rivers have brackish water, and the fresh water of rivers may flow far out into the sea. Failure to find chemical changes does not exclude death by drowning.

Other blood examinations which have been used in similar fashion are comparative determinations of calcium, of the specific gravity, the red cell volume, the freezing point, and the electric conductivity.

Pleural fluid in decomposed bodies after sea-water drowning reveals high chloride values, but results should be interpreted with caution since at present an insufficient number of controlled cases has been studied.

Large amounts of magnesium in gastric or duodenal fluid suggest swallowing of sea water.

A recent development indicates that the lactic acid value in brain tissue rises sharply as the result of sudden severe anoxia. The finding of values in excess of 200 mgs. per 100 grams of brain tissue is considered to be sufficiently high to indicate that this has occurred. This test may prove useful in confirming a suspicion of death due to drowning.

Chemical examination for poisons can be of importance in cases of drowning. Alcohol may be found both in suicide and accidental death, and may also identify fluid found in the stomach. Barbiturates point to suicide in a victim of drowning, and can explain death from submersion in a bathtub. Volatile poisons are rapidly eliminated, organic poisons are soon destroyed by putrefaction, while metallic poisons persist.

The task of evaluating the findings of investigations and autopsy is often difficult and sometimes hopeless. The best proofs of drowning beyond witnessed events are aqueous emphysema, large amounts of froth, Paltauf's spots, fluid from the site of immersion in the duodenum with a closed pylorus, hemorrhages along neck and pectoral muscles, water-borne material in hands closed by rigor, early, positive sodium chloride determination, and brain lactic acid studies. Plankton, especially diatoms, in the periphery of the lung, and in other organs, is the sign of drowning which persists longest. Positive proof of drowning is often impossible. Frequently the evaluation of more or less positive findings depends on their number and quality. Great care must be taken to exclude other causes of death. If none are found, drowning is usually assumed to be the probable cause. In civil matters there is a presumption at law that a body found in water drowned. Burden of proof of a different death rests on the claimant.

The manner of death, accident, suicide, natural, homicide, or undetermined, is likewise often problematic, even though the cause of death is fully established.

Accidental death is most common, and therefore generally assumed if nothing else can be proven. The question of accidental versus natural death arises in double indemnity claims. Reports of witnesses, inability to swim or to swim well, known dangers of a beach, such as whirlpools, holes and strong currents, a body found clad in a bathing suit, an over-turned boat, dense fog along the shore, signs of diving into mud, high blood alcohol concentration, and other evidence will point to accident.

Suicide can be assumed from letters, from weights clearly self-attached, from partial disrobing, or clothes piled neatly on the shore, from a history of depression, and autopsy findings suggestive of possible depression. Combined suicides occur. Drowning and shooting oneself, or cutting the wrists, or taking a high does of narcotics before entering the bathtub or other waters are examples. Women commit suicide by drowning more often than men.

A sudden collapse sometime after entering the water, or a history of angina pectoris, may point to natural death.

Homicide by drowning is suggestive by evidence of a preceding fight on shore or in water, by material possibly derived from an aggressor in the victim's hands, or under his nails, and by homicidal injuries. A live victim believed to be dead, may be thrown into water and drown. The way in which weights are attached may tell the story of a body disposed of after murder. Pushing a non-swimmer into water, turning over a boat with a non-swimmer, holding a head under water, especially that of an infant, may leave no proof. Circumstantial evidence may point strongly to homicide, or as with all circumstantial evidence, may be misleading, as in Dreiser's "American Tragedy". One should remember that the order of frequency is accidental, suicidal and homicidal, and that the last is rare.

In many cases the manner of death is best classified as "undetermined". The final decision rests with the police, the medical examiner, or the judge and jury, not with the pathologist.

NOTES

NOTES

* * * * *

# Miscellaneous Articles

* * * * *

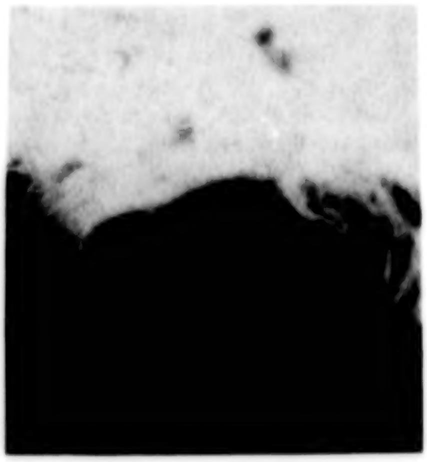
# Fiber Evidence and the Wayne Williams Trial

By
HAROLD A. DEADMAN
*Special Agent*
*Microscopic Analysis Unit*
*Laboratory Division*
*Federal Bureau of Investigation*
*Washington, D.C.*

On February 26, 1982, a Fulton County, Ga., Superior Court jury returned a verdict of "guilty as charged" on two counts of murder brought against Wayne Bertram Williams by a Fulton County grand jury in July 1981. Williams had been on trial since December 28, 1981, for the asphyxial murders of Nathaniel Cater and Jimmy Payne in April and May of 1981. During the 8-week trial, evidence linking Williams to those murders and to the murders of 10 other boys or young men was introduced.

An essential part of this case, presented by the Fulton County District Attorney's Office, involved the association of fibrous debris removed from the bodies of 12 murder victims with objects from the everyday environment of Williams.

Fiber evidence has often been an important part of criminal cases, but the Williams trial differed from other cases in several respects. Fiber evidence has not played a significant role in any case involving a large number of murder victims. The victims whose deaths were charged to Williams were 2 of 30 black children and black young men who were reported missing or who had died under suspicious circumstances in the Atlanta area over a 22-month period beginning in July 1979. During the trial, fiber evidence was used to associate Williams with 12 of those victims.



Fiber evidence is often used to corroborate other evidence in a case—it is used to support other testimony and validate other evidence presented at a trial. This was not the situation in the Williams trial. Other evidence and other aspects of the trial were important but were used to support and complement the fiber evidence, not the usual order of things. The "hair and fiber matches" between Williams' environment and 11 of the 12 murder victims discussed at the trial were so significant that in the author's opinion, these victims were positively linked to both the residence and automobiles that were a major part of the world of Wayne Williams.

Another difference between this case and most other cases was the extremely large amount of publicity surrounding both the investigation of the missing and murdered children and the arrest and subsequent trial of Williams. Few other murder trials have received the attention that the Williams case received.

(Published by the Federal Bureau of Investigation, U.S. Department of Justice)
Reprinted from the FBI Law Enforcement Bulletin, March and May, 1984.

*Special Agent Deadman*

Because of the extensive publicity and because the fiber evidence was so important, many questions about the significance of fiber evidence were brought to the attention of the public. There was considerable speculation concerning the fiber evidence. Questions concerning the meaning of a "fiber match" and about the proper procedures and techniques to be used in the characterizations and comparisons of textile fibers were discussed in newspapers and magazines.

Much of the pretrial speculation concerning the value of fiber evidence was negative. Comments such as "Fiber evidence just isn't reliable at all" and ". . . defense lawyers expressed skepticism about the legal impact of fiber evidence . . ." were published in the press.[1] There was also skepticism within the law enforcement community as to the meaning of the fiber findings, especially prior to Williams becoming a suspect. This skepticism was somewhat surprising because, as noted earlier, the introduction of fiber evidence at a criminal trial in order to link or associate a suspect with a victim or a suspect (or victim) with a crime scene is not new.

The FBI has conducted hair and fiber examinations and comparisons routinely for over 30 years at its Washington, D.C., Laboratory. Ten examiners in the Microscopic Analysis Unit of the FBI Laboratory work full time conducting these hair and fiber examinations for any law enforcement agency in the United States. In fiscal year 1981, these examiners conducted 43,043 examinations in 2,300 cases. During that time, they made 156 testimony trips to city, county, State and/or Federal courts. Many other laboratory systems worldwide routinely conduct hair and/or fiber examinations.

Why, then, should there have been this negative speculation about fiber evidence? Why is it that fiber examinations and their results have not been given the importance afforded other types of physical evidence?

This article presents the importance of forensic fiber examinations. It is a nontechnical overview of this field, discussing many aspects of a forensic fiber examination. Evidence presented at the Williams trial and testimony concerning this evidence are used to illustrate both the importance and use of fiber evidence in a trial situation. Many of the arguments discussed in this article were used to justify conclusions at the Williams trial and can be applied to fiber evidence in other trials. Problems and misconceptions concerning fiber examinations will also be addressed.

It is often difficult to get an accurate picture from press reports of the physical evidence introduced at a trial and the significance of that evidence. This article will also set forth in some detail the fiber evidence that linked Williams to the murder victims.

By discussing only the fiber evidence introduced at the trial, many other aspects of the case against Williams are being neglected. Additional evidence dealing with Williams' motivations—his character and behavior, his association with several of the victims by eyewitness accounts, and his link to a victim recovered from a river in Atlanta—was also essential to the case.

## Fibers in the Environment

Many objects in our environment—clothing, ropes, rugs, blankets, etc.—are composed of yarns made of textile fibers. A textile fiber, defined as the smallest part of a textile material, can be classified into one of four categories.

The animal fiber category includes wool (hairs) from sheep, cashmere hairs from the Kashmir goat, and silk fibers (filaments) from silkworms, to mention a few. Silk fibers and animal hairs other than wool are seldom used. Even woolen fibers currently occupy less than 1 percent of all fibers used in the production of textile materials in the United States.[2]

Of the many fibers in the vegetable fiber category, only the cotton fiber is found to any large extent in items of clothing. Approximately 24 percent of the total United States textile fiber production in 1979 was cotton.[3] Other plant fibers, such as jute and sisal, are used primarily for industrial purposes and are seen in various types of cordage and baggings.

Asbestos fibers are the only natural fibers found in the mineral fiber category. Seldom used in items of clothing or household objects, they are rarely found in either the composition of or the debris from items received in crime laboratories.

The majority of fibers seen in U.S. crime laboratories are from the manmade fiber type category. Manmade fibers represent approximately 75 percent of the total textile fiber production in the United States. Those seen most often include acetate, rayon, nylon, acrylic, polyester, and olefin fibers. These are 6 of the 21 generic classifications that have been established by the U.S. Federal Trade Commission to include all manufactured textile fibers. It is important to emphasize that even when considering only these six common classifications, there is an extremely large number of different "fiber types" produced by the many fiber producers throughout the world. A manmade fiber type can be defined as a fiber of a particular chemical composition that has been manufactured into a particular shape and size, contains a certain amount of various additives, and has been processed in a particular way. Within these six common generic classifications, there are well over a 1,000 different fiber types, each differing from the other in one or more of the above-mentioned variations. Therefore, numerous fiber types can be present in the composition of textile materials. This is true even before considering differences in color.

## Fibers and the Crime Laboratory

Why is the crime laboratory interested in textile fibers? In 1928, Edmond Locard first published his ideas concerning the transference of trace materials resulting from contact between people and objects. The exchange principle of Locard may be briefly summarized as follows: "When any two objects come into contact, there is always a transfer of material from each object on to the other."[4] Certainly, this is valid with many types of textile materials because of the ease with which fibers can be both lost (shed) and picked up. Since all people are closely associated with items containing fibrous materials, e.g., in their houses, automobiles, and on their person, the transference of textile fibers comes into play in many different types of criminal activity, especially in crimes of violence. When it is important to show that contact has taken place, textile fiber evidence can be invaluable.

Though fibers would seem to offer a wealth of evidence, their importance is often not fully appreciated, and sometimes, they are not even collected in criminal cases. There are several reasons for the general "low regard" attributed to fiber evidence, as compared to other types of physical evidence. In most cases, fibers are small in size and are often not easily seen or detected with the naked eye. They can be easily overlooked by someone not specifically looking for them. Even if crime scene investigators were aware of the presence of fibrous materials, special precautions to locate and preserve them are often necessary.

The small size of textile fibers should not be a problem to the investigator during evidence collection. The actual recovery of fibers from an object can be accomplished in the laboratory if the object is handled properly by crime scene personnel.

It should be noted that the size of fibers, as well as other features, such as the ease of transfer, actually benefit the investigator because perpetrators of crimes are not aware that they have been left behind or picked up evidence. Even if one were aware of fibrous materials being transferred, their small size would normally prevent one from doing anything about it.

A more serious problem is the lack of understanding about the significance of an association based upon a fiber match. Often, fiber evidence is dismissed in the courtroom as being meaningless by defense attorneys and defense experts. The degree of the significance of a fiber match, therefore, is of primary concern to prosecutors and investigators, as well as to those forensic scientists having little experience in fiber comparisons.

*Figure 1*

**[illegible] CHARACTERISTICS EXHIBITED BY TEXTILE FIBERS**

1– [illegible]
2– SIZE [illegible]
3– SHAPE (Cross section)
4– FIBER OR YARN PROCESSING
5– [illegible]
6– SURFACE CHARACTERISTICS
7– SURFACE DEBRIS
8– DAMAGE
9– VARIATIONS IN ABOVE CHARACTERISTICS WITHIN A FIBER

*Figure 2*

**OPTICAL PROPERTIES OF TEXTILE FIBERS**

1– ISOTROPIC REFRACTIVE INDEX
2– [illegible] PARALLEL [illegible]
3– [illegible] PERPENDICULAR [illegible]
4– [illegible]
5– SIGN OF BIREFRINGENCE
6– DICHROISM
7– FLUORESCENCE
8– ABSORPTION SPECTROSCOPY

**Establishing Significance**

An association made by matching a single fiber or several loose fibers, all similar in their properties to the fibers in a designated object, is not a positive association. An association of this type does not associate those fibers with a particular object to the exclusion of all other similar objects. Objects containing a particular type of fiber and dyed in a certain manner may have been manufactured by the thousands either at one time or at different times. Likewise, the same type of dyed fiber could be present in several different types of objects. The "questioned fibers" (fibers of unknown origin) in a case could have originated from any of these many objects containing the same fiber type. It should be pointed out that these many objects would normally not all be located in one area.[5] If an association is to be made, it must be possible for an object that could be the source of a transferred ("questioned") fiber to be at or linked to the location where that fiber was found. If, then, a single "fiber match" cannot be deemed a positive association, as in the case of a fingerprint, what can be the significance of such a match?

Let us consider what a forensic fiber examiner is concerned with when conducting a comparison in a crime laboratory. He must determine that a "questioned fiber" is similar to or the same as fibers in the composition of a particular object. There can be no significant differences detected by the examiner when matching such fibers. In making this determination, the fiber examiner must compare various characteristics and properties which can be observed and/or determined. Visual characteristics include color, size, cross-sectional shape, and surface appearance. Other properties are dependent upon a fiber's composition, the conditions under which it was manufactured or processed, and the dye formulation used to color it. Also, environmental and consumer handling effects, such as fading and abrasion, may be the cause of changes in these characteristics.

Many techniques are available to the forensic scientist for the examination and comparison of these properties. It would be unrealistic and unnecessary for the forensic scientist to use all of them. There are several relatively simple but very discriminating microscopical procedures that should be performed first. A combination of microscopical procedures is especially discriminating in the comparison of colored manmade fibers. Equipment used in the fiber examinations in the Williams case included a comparison microscope, a polarized light microscope, a fluorescence microscope, and a microspectrophotometer. Fiber properties and characteristics can be studied and compared with the use of

the microscopical equipment mentioned above. (See figs. 1 and 2.)

Whether other comparison procedures are necessary and the sequence in which they should be performed are important considerations to the fiber examiner, but they are beyond the scope of this article.

Once it has been determined that there is a fiber match, the significance of the resulting association depends considerably upon whether the fiber type involved in that fiber match is uncommon or unusual. The more uncommon the fiber type, the smaller the chance of finding that particular fiber type in a specific location (either in the composition of a particular fibrous object or in the fibrous debris removed from a particular object).

How is one to determine whether a fiber can be considered common or uncommon? An experienced forensic fiber examiner who has examined the composition of numerous materials can usually make an intuitive, yet accurate, determination as to whether a fiber type is uncommon. In some instances it is also possible for the examiner to develop information about a particular fiber type to establish that it is uncommon. In addition, forensic laboratories in England are presently accumulating data about the fiber types and fiber colors that they see in the various fibrous materials they examine. By classifying all fibers found in the composition of objects received in many of England's crime laboratories, they will eventually have sufficient data to make a statistically based determination as to whether a particular fiber type is common or uncommon. Until sufficient data is obtained from the above-mentioned project, the major criterion for determining what is uncommon is the judgment of an experienced examiner.

The significance question can be addressed by dividing fiber types into four groups, based primarily upon what the experienced examiner has determined and/or has come to recognize as being common and uncommon.

The first group consists of common types of fibers used in the construction of large numbers of objects. An example is undyed or off-white (lightly dyed) cotton. Most white cotton fibers, even though from different sources, will be very similar in appearance, as well as in other properties and characteristics. Because the sources of these fiber types are numerous and because it is usually impossible to distinguish these fibers from different sources, an association based on this type of "fiber match" has little, if any, meaning. A white cotton fiber would be expected to be found not only in the composition of many textile items, but also in the debris removed from many items. Other common fibers which are of limited value for significant comparison purposes include many of the white and off-white polyester fibers often used in sheets, pillowcases, underwear, and men's dress shirts. Still others include various colors of cotton fibers, such as blue cotton fibers, found in many types of blue jeans.

The second group consists of "uncommon fiber types" and can be further subdivided into three categories. The first category includes colored fiber types used in the construction of a relatively small number of items. Normally, it would be difficult and very time consuming to obtain the data necessary to show that a fiber type has been used in only a small number of items.[6] In the Williams' case, many victims were linked to the carpet in Williams' bedroom. These associations were very significant because it was possible to show that the bedroom carpet was manufactured in comparatively small amounts and for only a short period of time. These conclusions were arrived at from sales records and other information obtained from the carpet manufacturer.

The second category of uncommon fiber types includes those in objects manufactured many years ago. As time passes, these objects become fewer and fewer in number. The Williams bedroom carpet also falls into this category because similar carpet has not been manufactured since December 1971.

The third category of uncommon fiber types includes those which, while they may be present in a large number of different items, occur in items with which people do not normally come in contact. Accordingly, these fiber types would not usually be found in debris from someone's clothing. Only the experienced forensic fiber examiner could determine whether a fiber type would fit into this group. This is because only the forensic fiber examiner is concerned with the identification and comparison of fibrous debris removed from clothing and other objects.

Fibers from all three categories of uncommon fiber types were present in items from Williams' environment and were found to match fibers present in debris removed from the bodies or clothing of various victims.

The carpet in Williams' 1970 station wagon is uncommon because similar carpet was last installed by the vehicle's manufacturer in 1973. It is composed of rayon and nylon fibers,

a blend which has not been used in any type of carpet for a number of years. Even though this style and color of carpet was installed in many cars prior to 1974, the existing amount of this carpet gets smaller and smaller each year. Rayon fibers presently used for purposes other than for carpet are not as coarse as those used in automotive carpet and therefore could not be confused with rayon carpet fibers.

Trunk liners in two other cars that Williams had access to in 1979 and 1980 were composed of fibers that are not normally seen by crime laboratory personnel. This is true even though the manufacturers of these cars would have used trunk liners similar to those in Williams' automobiles in thousands of cars. The trunk liners in Williams' cars were composed of undyed manmade fibers that had a black adhesive material on their surfaces. Even though many similar trunk liners are in existence, the trunk liner fiber type is generally not seen in debris removed from clothing. Since these fibers are apparently not used for purposes other than trunk liners, someone would essentially have to be inside a trunk to have these fibers appear on his clothing.

The majority of other fibers fall into the third group, which includes all manmade fiber types dyed with particular dye formulations. Associations based on matching these fiber types are meaningful, even though these fiber types could not be shown to be unusual or uncommon, because considerable additional variety is present due to the fibers being colored. Dyed manmade fibers can be the basis for strong associations, since any one type of these colored fibers is an extremely small percentage of all the fiber types that exist. The chance of randomly finding any one manmade fiber type of a specific color in a particular location is extremely low; however, it would be nearly impossible to obtain actual probability estimates. There is enormous variety within the six common generic classes considering only undyed fibers. When color is added to these manmade fiber types, the variety is increased tremendously, thereby increasing the significance of a fiber match. There are about 7,000 dyes in existence, many of which are used to color either natural fibers or manmade fibers.[7] Although these dyes can be used individually, they are often mixed together in combinations of two or more individual dyes. This mixing of different dyes results in a colored fiber having a particular dye formulation (a listing of the type and amount of each individual dye). These dye formulations are usually unique to a particular manufacturing company and change often as the popularity of colors and shades changes. Even though there may be only several hundred different colors that the eye can distinguish, there are many different ways in which these colors can be obtained. Companies seldom, if ever, attempt to exactly duplicate another's dye formulation.

If there are well over a 1,000 different manmade fiber types produced and if each textile producer uses different dye formulations to color its textile materials, the result is an extremely large number of fiber types that could be distinguished from one another. Each individual colored manmade fiber type would then be a very small percentage of all the fiber types that exist.

A preliminary study conducted in England illustrates the small chance of finding a particular fiber type in a randomly selected location. It was conducted to determine the likelihood of finding fibers in debris like those in a particular garment by pure coincidence. In this study, four control sweaters were selected that had been produced in large numbers over a long period of time and had been distributed widely throughout England. These sweaters were composed of woolen fibers and/or different types of manmade fibers. The fibrous debris from 250 garments that had been submitted to the laboratory system were searched and only 6 woolen fibers were found that matched 1 of the 4 sweaters (the most common of these sweaters). A maximum of two fibers consistent with this woolen sweater was found in the fibrous debris from any one garment. No fibers consistent with the other three sweaters (composed in part of dyed manmade fibers) were located. The authors of this study concluded that although many more garments should be examined, it appears that to find more than a small number of fiber matches by pure coincidence would be extremely unlikely.[8]

Obviously, there will be an overlapping within the three groups described as "common," "uncommon," and "colored manmade." Some fiber types that fit none of these groups fall into a fourth group. This fourth group would include colored cotton fibers and colored woolen fibers. With natural fibers, color is the most important characteristic used for comparison.

**GENERAL CONSIDERATIONS—FIBER EVIDENCE CRIME SCENE**

1. Obtain and package as soon as possible
   a. Before it is lost
   b. Before contamination
2. Look for the obvious
   a. Clumps of fibers
   b. Pieces of fabric, tape, rope, yarns, thread, individual filaments
   c. Fabric impressions (possibility of fibers being present)
3. Locate logical sources for fibrous evidence found on a victim or at a crime scene
   a. Carpet and rugs
   b. Upholstery
   c. Bedding
   d. Suspect's clothing
   e. Wigs, hairpieces, fake fur
   f. Cordage and tape
4. Miscellaneous considerations
   a. Photograph locations of fibers, pieces of fabric, and fabric impressions
   b. Obtain entire item, if possible
   c. Obtain lifts of impressions when entire item is not obtainable

**PACKAGING FIBROUS EVIDENCE**

1. PROTECT EVIDENCE from:
   a. Contamination
   b. Loss of trace evidence
   c. Further damage
2. PROTECT stab holes, bullet holes and impressions (in blood, soil, etc.) DO NOT FLATTEN!
3. Remove fibers, yarns, etc. which may become dislodged (noting exactly where removed from item)
4. Cover area of an item (e.g. baseball bat) which contains fibers (etc.) with paper (seal edges)
5. Wrap *fabric impressions* so that: (1) they cannot be rubbed or scratched, (2) fibers cannot be lost, (3) no contamination can take place and (4) impression is not flattened.
6. Use *separate boxes* to package containers of evidence from *different people* and/or from *different locations*.
7. Identify (mark) and seal each container
8. Do not place fibers, yarns, etc. *directly* into plastic or glass containers

Use *paper* (folded in druggist fold) or *paper* envelopes (seal all 4 corners); these paper containers can then be placed into a plastic envelope and sealed.

**CASES WHERE FIBER AND FABRIC EVIDENCE CAN BE IMPORTANT**

1. Crimes of violence (murder, rape, assault)
   a. Transfer of individual fibers between suspect objects and victim objects
      1. Items of clothing
      2. Carpet (residential and automotive)
      3. Bedding
      4. Hair combings (head and pubic)
      5. Fingernail scrapings
      6. Adhesive surfaces of tape
   b. Fibrous materials left behind at crime scene by suspect or victim
      1. Clothing, wigs, masks, hats
      2. Gloves
      3. Portions of fibrous materials (cut or torn)
      4. Pieces of tape and cordage
      5. Button (with attached fibrous materials)
   c. Weapons and damage from weapons
      1. Guns, knives, clubs, ice picks
      2. Stab and bullet holes
   d. Impressions on fabric (shoe or hand print in blood)
2. Arson
   a. Portions of fuses
   b. Fabric in bottles
   c. Charred portions of garments
3. Robbery, burglary, breaking and entering
   a. Items left at crime scenes
      1. Masks, hat, wigs, clothing
      2. Pieces of fabric
   b. Items and fibrous material along getaway route
   c. Fibers and fabric found at point of entry and exit
4. Extortion
   a. Fibers under envelope flap, tape, and stamps on envelope
   b. Glove impressions
5. Hit and Run
   a. Fibers and fabric on vehicle
   b. Fabric impressions on vehicle
6. Explosive Devices
   a. Fibrous debris from tape
   b. Tape, cordage, and fabric comparisons

Associations with these fibers can be meaningful if the laboratory uses a discriminating technique such as thin-layer chromatography or microspectrophotometry to compare color.

There are other factors that must be considered when assessing the significance of a fiber match.[9] These conditions will be discussed when the results of the fiber examinations in the Williams case are discussed. Apart from the frequency of the fibers involved, various circumstances can measurably add or detract from the strength of an association.

**Recovery of Fibrous Materials**

Collection of fibrous materials may be from the scene of a crime, from a body, or from any setting where fibers of importance may be present. In the majority of cases, the investigator has the responsibility of obtaining fibrous evidence or at least maintaining the actual evidence in such a way that loosely adhering fibrous debris will not be lost. When a murder victim is involved, a crime scene search must be conducted at the recovery site. Also, a thorough examination must be made of the body away from the crime scene, preferably before and during the autopsy.

Human and animal hairs, as well as textile fibers, can be important. All fibrous materials should be collected at the same time. It is also important to realize that procedures used to collect fibrous evidence may interfere with or prevent the recovery of other types of evidence and vice versa. The crime scene search must be organized to prevent the loss of all types of evidence.

*Figure 3*

**RECOVERY OF FIBER EVIDENCE FROM CRIME SCENE OF A MURDER VICTIM**

1. Limit access to crime scene
2. Photograph body
3. Visual inspection (special lighting) of body and surrounding area
4. Use of transparent tape on exposed body areas
5. Place bags over victim's hands
6. Use new white sheets to transport body
7. Obtain all clothing and sheets; place each item into a separate paper bag at morgue or hospital
8. Close visual inspection of body at autopsy (best with magnification)
9. Use of white cotton packed into teeth of comb to collect fibrous debris from head hair and pubic hair areas, at autopsy
10. Consider evidence associated with transportation of body to crime scene
11. Consider use of vacuum cleaner for large amounts of fibrous debris

*Figure 4*

**VALUE OF FIBER EXAMINATIONS**

1. Establish a sequence of events
2. Link a murder weapon with a victim or suspect
3. Help to corroborate a victim's account of circumstances surrounding an assault
4. Provide leads to investigators about murder victim's surroundings at time of murder
5. Link together a number of different (sometimes apparently unrelated) victims or criminal activities
6. Establish a high probability that contact or some other association has taken place between people and/or objects

The investigator must be aware that in virtually all criminal situations, fiber evidence will be involved. This is particularly true in crimes of violence, especially in murder cases where the victim's body has been moved. All items of clothing and other items of importance should be obtained as quickly as possible and secured in paper bags. If hairs and fibers are seen by the investigator, they should be placed inside a sheet of paper which, after folding and labeling, can be placed inside another container.

The actual methods of fiber recovery used depend upon individual circumstances. Since many of these procedures are best carried out at the medical examiner's or coroner's laboratory, the investigator should coordinate his activities with one of these laboratories. It should be the responsibility of the investigator to remind those conducting the autopsy to be aware of fibrous materials and also to conduct their examinations in a manner that would prevent contamination. (See fig. 3.)

There are a number of procedures and techniques that can be used in the crime laboratory for the collection of fibrous material from items received, including removing of debris with tweezers, scraping fibrous debris from objects with a spatula, using tape to remove fibrous debris, and vacuuming. Some of these techniques have been discussed in forensic science literature and a study of the efficiency of these techniques has also been published.[10] The technique selected normally depends upon the circumstances of the case, as well as the equipment, space, and facilities of the crime laboratory. An important aspect of the fiber recovery procedure in the crime laboratory, regardless of the procedures used, is a program of contamination prevention.

When properly done, the collection process is laborious and time-consuming. However, many benefits can result in evidence obtained from a thorough search. (See fig. 4.) These benefits are nowhere more apparent than in a review of the Williams case. However, before discussing the actual trial, it is interesting to see how Williams was developed as a suspect in the Nathaniel Cater murder. Part II of this article will deal with this subject and the fiber evidence presented at his trial.

### Development of Williams as a Murder Suspect

Before Wayne Williams became a suspect in the Nathaniel Cater murder case, the Georgia State Crime Laboratory located a number of yellowish-green nylon fibers and some violet acetate fibers on the bodies and clothing of the murder victims whose bodies had been recovered during the period of July 1979, to May 1981. The names of those victims were included on the list of missing and murdered children that was compiled by the Atlanta Task Force (a large group of investigators from law enforcement agencies in the Atlanta area). The yellowish-green nylon fibers were generally similar to each other in appearance and properties and were considered to have originated from a single source. This was also true of the violet acetate fibers. Although there were many other similarities that would link these murders together, the fiber linkage was notable since the possibility existed that a source of these fibers might be located in the future.

Initially, the major concern with these yellowish-green nylon fibers was determining what type of object could have been their source. This information could provide avenues of investigative activity. The fibers were very coarse and had a lobed cross-sectional appearance, tending to indicate that they originated from a carpet or a rug. The lobed cross-sectional shape of these fibers, however, was unique, and initially, the manufacturer of these fibers could not be determined. Photomicrographs of the fibers were prepared for display to contacts within the textile industry. On one occasion, these photomicrographs were distributed among several chemists attending a meeting at the research facilities of a large fiber producer. The chemists concurred that the yellowish-green nylon fiber was very unusual in cross-sectional shape and was consistent with being a carpet fiber, but again, the manufacturer of this fiber could not be determined. Contacts with other textile producers and textile chemists likewise did not result in an identification of the manufacturer.

In February 1981, an Atlanta newspaper article publicized that several different fiber types had been found on two murder victims. Following the publication of this article, bodies recovered from rivers in the Atlanta metropolitan area were either nude or clothed only in undershorts. It appeared possible that the victims were being disposed of in this undressed state and in rivers in order to eliminate fibers from being found on their bodies.[11]

On May 22, 1981, a four-man surveillance team of personnel from the Atlanta Police Department and the Atlanta Office of the FBI were situated under and at both ends of the James Jackson Parkway Bridge over the Chattahooche River in northwest Atlanta. Around 2:00 a.m., a loud splash alerted the surveillance team to the presence of an automobile being driven slowly off the bridge. The driver was stopped and identified as Wayne Bertram Williams.

Two days after Williams' presence on the bridge, the nude body of Nathaniel Cater was pulled from the Chattahoochee River, approximately 1 mile downstream from the James Jackson Parkway Bridge. A yellowish-green nylon carpet-type fiber, similar to the nylon fibers discussed above, was recovered from the head hair of Nathaniel Cater. When details of Williams' reason for being on the bridge at 2:00 a.m. could not be confirmed, search warrants for Williams' home and automobile were obtained and were served on the afternoon of June 3, 1981. During the late evening hours of the same day, the initial associations of fibers from Cater and other murder victims were made with a green carpet in the home of Williams. Associations with a bedspread from Williams' bed and with the Williams' family dog were also made at that time.

An apparent source of the yellowish-green nylon fibers had been found. It now became important to completely characterize these fibers in order to verify the associations and determine the strength of the associations resulting from the fiber matches. Because of the unusual cross-sectional appearance of the nylon fiber and the difficulty in determining the manufacturer, it was believed that this was a relatively rare fiber type, and therefore, would not be present in large amounts (or in a large number of carpets).

### The Williams Carpet

Shortly after Williams was developed as a suspect, it was determined the yellowish-green nylon fibers were manufactured by the Wellman Corporation. The next step was to ascertain, if possible, how much carpet like Williams' bedroom carpet had been sold in the Atlanta area—carpet composed of the Wellman fiber and dyed with the same dye formulation as the Williams' carpet. Names of Wellman Corporation customers who had purchased this fiber type, technical information about the fiber, and data concerning when and how much of this fiber type had been manufactured were obtained.

It was confirmed that the Wellman Corporation had, in fact, manufactured the fiber in Williams' carpet and that no other fiber manufacturer was known to have made a fiber with a similar cross section. It was also determined that fibers having this cross-sectional shape were manufactured and sold during the years 1967 through 1974. Prior to 1967, this company manufactured only a round cross section; after 1974, the unusual trilobal cross section seen in Williams' carpet was modified to a more regular trilobal cross-sectional shape. A list of sales of that fiber type during the period 1967 through 1974 was compiled.

The Wellman Corporation described the fibers used in the construction of Williams' carpet as being composed of a nylon 6,6 polymer called Wellman 181B. The Wellman 181B fiber was sold to 12 companies from 1967 to 1974 in undyed sections, each 6 inches in length. The purchasers, for the most part, were carpet yarn spinners (companies that prepare yarn from loose fibers). After a carpet yarn is prepared, it is then used to manufacture the face (pile) of the actual carpet. In order to determine the manufacturer of Williams' carpet, it was necessary to contact all purchasers of Wellman carpet fiber like that used in his carpet. These companies, normally those who prepare carpet yarn only, were asked to furnish the names of carpet manufacturers who had purchased carpet yarn made of Wellman 181B fibers.

At the outset, a problem arose. A number of companies either having purchased Wellman 181B fibers or having manufactured carpet from yarn composed of Wellman 181B fibers were no longer in business. Therefore, it was necessary to locate former employees of the defunct companies to see if they could recognize the fibers in Williams' carpet or recognize an actual piece of the carpet from Williams' room. In each of these contacts, a sample of the carpet from Williams' home was made available for display by investigators.

Through numerous contacts with yarn spinners and carpet manufacturers, it was determined that the West Point Pepperell Corporation of Dalton, Ga., had manufactured a line of carpet called "Luxaire," which was constructed in the same manner as the Williams' carpet. One of the colors offered in the "Luxaire" line was called "English Olive," and this color was the same as that of the Williams' carpet (both visually and by the use of discriminating chemical and instrumental tests).

It was learned that the West Point Pepperell Corporation had manufactured the "Luxaire" line for a 5-year period from December 1970 through 1975; however, it had only purchased Wellman 181B fiber for this line during 1970 and 1971. In December 1971, the West Point Pepperell Corporation changed the fiber composition of the "Luxaire" line to a different nylon fiber, one that was dissimilar to the Wellman 181B fiber in appearance. Accordingly, "Luxaire" carpet, like the Williams' carpet, was only manufactured for a 1-year period. This change of carpet fiber after only 1 year in production was yet another factor that made the Williams' carpet unusual.

It is interesting to speculate on the course the investigation would have taken if the James Jackson Parkway Bridge had not been covered by the surveillance team. The identification of the manufacturer of the nylon fibers showing up on the bodies could still have occurred and the same list of purchasers of the Wellman fiber could have been obtained. The same contacts with the yarn and carpet manufacturers could have been made; however, there would not have been an actual carpet sample to display. It is believed that eventually the carpet manufacturer could have been determined. With a sample of carpet supplied by West Point Pepperell—which they had retained in their files for over 10 years—it would have been possible to conduct a house-by-house search of the Atlanta area in an attempt to find a similar carpet. Whether this very difficult task would have been attempted, of course, will never be known. A search of that type, however, would have accurately answered an important question that was discussed at the trial—the question of how many other homes in the Atlanta area had a carpet like the Williams' carpet. An estimation, to be discussed later, based on sales records provided by the West Point Pepperell Corporation indicated that there was a very low chance (1/7792) of finding a carpet like Williams' carpet by randomly selecting occupied residences in the Atlanta area.

Only the West Point Pepperell Corporation was found to have manufactured a carpet exactly like the Williams' carpet. Even though several manufacturers had gone out of business and could not be located, it was believed that considering the many variables that exist in the manufacture of carpet and the probable uniqueness of each carpet manufacturer's dye formulations, it would be extremely unlikely for two unrelated companies to construct a carpet or dye the carpet fibers in exactly the same way. A large number of other green fibers, visually similar in color to Williams' carpet, were examined. None was found to be consistent with fibers from the Williams carpet.

## Probability Determinations

To convey the unusual nature of the Williams residential carpet, an attempt was made to develop a numerical probability—something never before done in connection with textile materials used as evidence in a criminal trial.[12] The following information was gathered from the West Point Pepperell Corporation:

1) West Point Pepperell reported purchases of Wellman 181B fiber for the "Luxaire" line during a 1-year period. The Wellman 181B fiber was used to manufacture "Luxaire" carpet from December 1970, until December 1971, at which time a new fiber type replaced that Wellman fiber.
2) In 1971, West Point Pepperell sold 5,710 square yards of English Olive "Luxaire" and "Dreamer" carpet to Region C (10 southeastern States which include Georgia). "Dreamer" was a line of carpet similar to "Luxaire" but contained a less dense pile. In order to account for the carpet manufactured during 1971, but sold after that time, all of the "Luxaire" English Olive carpet sold during 1972 to Region C (10,687 square yards) was added to the 1971 sales. Therefore, it was estimated that a total of 16,397 square yards of carpet containing the Wellman 181B fiber and dyed English Olive in color was sold by the West Point Pepperell Corporation to retailers in 10 southeastern States during 1971 and 1972. (In 1979, existing residential carpeted floor space in the United States was estimated at 6.7 billion square yards.)[13]
3) By assuming that this carpet was installed in one room, averaging 12 feet by 15 feet in size, per house, and also assuming that the total sales of carpet were divided equally among the 10 southeastern States, then approximately 82 rooms with this carpet could be found in the State of Georgia.
4) Information from the Atlanta Regional Commission showed that there were 638,995 occupied housing units in the Atlanta metropolitan area in November 1981.[14] Using this figure, the chance of randomly selecting an occupied housing unit in metropolitan Atlanta and finding a house with a room having carpet like Williams' carpet was determined to be 1 chance in 7,792—a very low chance.

To the degree that the assumptions used in calculating the above probability number are reasonable, we can be confident in arriving at a valid probability number. The assumptions made included:

1) The sales records provided by the West Point Pepperell Corporation were complete and accurate;
2) The carpet sold by West Point Pepperell containing Wellman 181B fiber dyed English Olive in color was distributed and installed equally throughout the 10 southeastern States;
3) All the carpet sold to retailers in Georgia was installed in the Atlanta metropolitan area.
4) Each residential unit contained only 20 square yards of the carpet in question;
5) All English Olive carpet sold in 1972 contained the Wellman 181B fiber, even though the use of that fiber type was discontinued in December 1971.
6) None of the English Olive carpet installed during 1971 and 1972 had been discarded; and
7) No other carpet manufacturer would produce a carpet containing Wellman 181B fiber dyed with essentially the same English Olive dye formulation.

With the exception of #2 and #7, the assumptions are conservative. In other words, the real probability number is likely to be smaller than 1 in 7,792. For example, if it were assumed that 60 square yards of the carpet had been installed in each house, then the probability number would become 1 in 23,406. (Williams' residence had over 60 square yards of the carpet).

If assumption #2 were changed so that one-half of the 16,397 square yards sold to the 10 southeastern States was sold (and subsequently installed) in metropolitan Atlanta, the probability of finding a residence containing 20 square yards of carpet like Williams' carpet would become 1 in 1,559.

The probability figures illustrate clearly that the Williams' carpet is, in fact, very uncommon. To enhance the figures even further, it is important to emphasize that these figures are based on the assumption that none of the carpet of concern had been discarded during the past 11 years. In fact, carpet of this type, often used in

commercial settings, such as apartment houses, would probably have had a normal lifespan of only 4 to 5 years.[15]

The validity of assumption #7 is arguable. However, considering the comparatively small amount of Wellman 181B fiber used to produce carpet, the nature of the coloring process used by the carpet industry, and the actual comparisons of many green carpet fibers, it is believed that no companies using Wellman 181B fiber would duplicate the dye formulation used by West Point Pepperell. (Four individual dyes were mixed to color the Wellman fiber in Williams' carpet.)

**The Williams Trial**

To any experienced forensic fiber examiner, the fiber evidence linking Williams to the murder victims was overwhelming. But regardless of the apparent validity of the fiber findings, it was during the trial that its true weight would be determined. Unless it could be conveyed meaningfully to a jury, its effect would be lost. Because of this, considerable time was spent determining what should be done to convey the full significance of the fiber evidence. Juries are not usually composed of individuals with a scientific background, and therefore, it was necessary to "educate" the jury in what procedures were followed and the significance of the fiber results. In the Williams case, over 40 charts with over 350 photographs were prepared to illustrate exactly what the crime laboratory examiners had observed. Several types of charts were prepared, including:

1) Educational charts to illustrate different classifications of textile fibers and to show the variety that can exist within one fiber classification. Charts listing the microscopes used, as well as the fiber properties and characteristics that are compared during microscopical comparisons.
2) A series of charts showing objects in Williams' environment which were linked to the various victims. These were used to facilitate reference to and discussion of particular objects.
3) Charts where photomicrographs of foreign fibers removed from a particular victim were shown next to photomicrographs of similar fibers from known objects in Williams' environment.

Each of the fiber photomicrographs was enlarged to an 8-by 10-inch color print to give a final magnification of approximately 600X. These 8- by 10-inch prints were cropped to a final size of 5-by 7-inches. As many as 16 prints could then be displayed on a standard size 30-by 40-inch chart.

Considerable time and expense were involved in the preparation of the charts used in the Williams trial. This was because of the tremendous amount of evidence linking Williams to the many victims. In a more typical case, where the fiber evidence is not so voluminous, charts and photographs could more easily be prepared.

Representatives of the textile fiber industry, including technical representatives from the Wellman and West Point Pepperell Corporations, were involved in educating the jury regarding textile fibers in general and helped lay the foundation for the conclusions of the forensic fiber examiners. The jury also was told about fiber analysis in the crime laboratory.

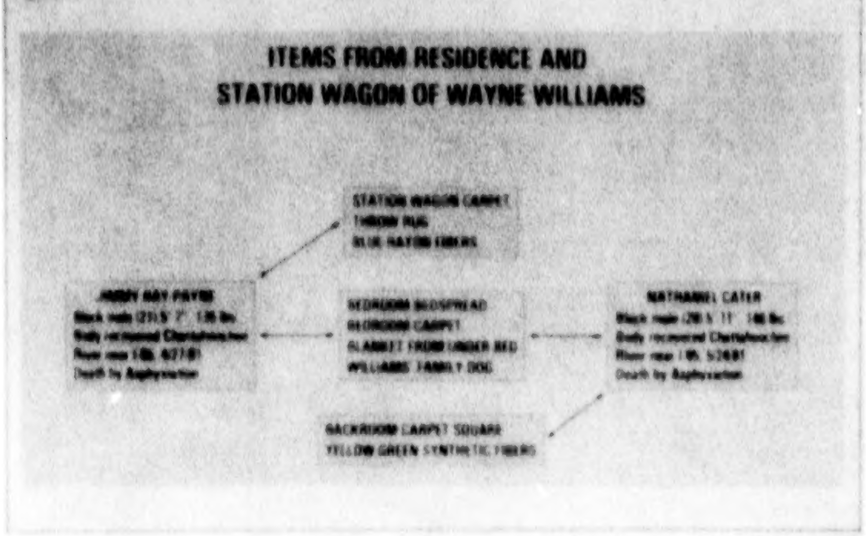
The trial, as it developed, can be divided into two parts. Initially, testimony was given concerning the murders of Nathanial Cater and Jimmy Ray Payne, the two victims included in the indictment drawn against Williams in July 1981. Testimony was then given concerning Williams' association with 10 other murder victims.

The fiber matches made between fibers in Williams' environment and fibers from victims Payne and Cater were discussed. The items from Williams' environment that were linked to either or both of the victims are shown in the center of the chart. (See fig. 5.) Not only is Payne linked to the Williams' environment by seven items and Cater linked by six items, but both of the victims are linked strongly to each other based on the fiber matches and circumstances surrounding their deaths.

In discussing the significance or strength of an association based on textile fibers, it was emphasized that the more uncommon the fibers, the stronger the association. None of the fiber types from the items in Williams' environment shown in the center of figure 5 is by definition a "common" fiber type. Several of the fiber types would be termed "uncommon."

One of the fibers linking the body of Jimmy Ray Payne to the carpet in the 1970 station wagon driven by Williams was a small rayon fiber fragment recovered from Payne's shorts.

Figure 5




Data were obtained from the station wagon's manufacturer concerning which automobile models produced prior to 1973 contained carpet made of this fiber type. These data were coupled with additional information from Georgia concerning the number of these models registered in the Atlanta metropolitan area during 1981. This allowed a calculation to be made relating to the probability of randomly selecting an automobile having carpet like that in the 1970 Chevrolet station wagon from the 2,373,512 cars registered in the Atlanta metropolitan area. This probability is 1 chance in 3,828, a very low probability representing a significant association.

Another factor to consider when assessing the significance of fiber evidence is the increased strength of the association when multiple fiber matches become the basis of the association. This is true if different fiber types from more than one object are found and each fiber type either links two people together or links an individual with a particular environment. As the number of different objects increases, the strength of an association increases dramatically. That is, the chance of randomly finding several particular fiber types in a certain location is much smaller than the chance of finding one particular fiber type.

The following example can be used to illustrate the significance of multiple fiber matches linking two items together. If one were to throw a single die one time, the chance or probability of throwing a particular number would be one chance in six. The probability of throwing a second die and getting that same number also would be one chance in six. However, the probability of getting 2 of the same numbers on 2 dice thrown simultaneously is only 1 in every 36 double throws—a much smaller chance than with either of the single throws. This number is a result of the product rule of probability theory. That is, the probability of the joint occurrence of a number of mutually independent events equals the product of the individual probabilities of each of the events (in this example—$\frac{1}{6} \times \frac{1}{6} = \frac{1}{36}$). Since numerous fiber types are in existence, the chance of finding one particular fiber type, other than a common type, in a specific randomly selected location is small. The chance then of finding several fiber types together in a specific location is the product of several small probabilities, resulting in an extremely small chance.

---

Probability theory has previously been used to some extent in determining the significance of evidence, but has often been used incorrectly. In most cases, an adequate foundation had not been laid for the individual probability estimates—a foundation that would include the validity of reasonableness of the figures used and a demonstration that individual probabilities are independent of one another. In the Williams case, it was believed that the probability numbers obtained were based on valid data and were, in fact, conservative estimates. However, no attempt was made to use the product rule and multiply the individual probability numbers together to get an approximation of the probability of finding carpets like Williams' residential carpet and Williams' automobile carpet in the same household. The probability numbers were used only to show that the individual fiber types involved in these associations were very uncommon.[16]

It should be noted that carpet is one of the few types of fibrous material that is suitable for statistical analysis. This is because manmade carpet fibers are usually dyed and have much larger diameters than textile fibers from most other sources. Most carpet fibers have cross-sectional shapes which are only used in carpet fibers and which often are unique to a particular fiber manufacturer. Therefore, a large diameter fiber, especially those that are colored, can usually be identified as having originated from a carpet. Additionally, because carpet is generally a high-cost item, accurate and complete sales records are more likely to exist.

*Figure 6*

| VICTIM'S NAME | DATE VICTIM MISSING | DAYS MISSING | BODY RECOVERY AREA | CAUSE OF DEATH | AGE | WEIGHT | HEIGHT |
|---|---|---|---|---|---|---|---|
| EVANS | 7/25/79 | 3 | WOODED AREA S.W. ATLANTA | PROBABLE ASPHYXIATION/ STRANGULATION | 13 | 87 LBS. | 5'4" |
| MIDDLEBROOKS | 5/18/80 | 1 | NEAR STREET S.E. ATLANTA | BLUNT TRAUMA TO HEAD | 14 | 88 LBS. | 4'10" |
| STEPHENS | 10/9/80 | 1 | NEAR STREET S.E. ATLANTA | ASPHYXIATION | 10 | 120 LBS. | 5'0" |
| GETER | 1/3/81 | 33 | WOODED AREA FULTON COUNTY | MANUAL STRANGULATION | 14 | 130 LBS. | 5'4" |
| PUE | 1/22/81 | 1 | NEAR HIGHWAY ROCKDALE CO. | LIGATURE STRANGULATION | 15 | 105 LBS. | 5'5" |
| BALTAZAR | 2/6/81 | 7 | NEAR HIGHWAY DEKALB CO. | LIGATURE STRANGULATION | 12 | 125 LBS. | 5'4" |
| BELL | 3/2/81 | 31 | SOUTH RIVER DEKALB CO. | ASPHYXIATION | 16 | 100 LBS. | 5'2" |
| ROGERS | 3/30/81 | 10 | NEAR STREET N.W. ATLANTA | ASPHYXIATION/ STRANGULATION | 20 | 110 LBS. | 5'3" |
| PORTER | 4/10/81 | 1 | NEAR STREET IN S.W. ATLANTA | STABBED | 28 | 123 LBS. | 5'7" |
| PAYNE | 4/22/81 | 5 | CHATTAHOOCHEE RIVER FULTON COUNTY | ASPHYXIATION | 21 | 135 LBS. | 5'7" |
| BARRETT | 5/11/81 | 1 | NEAR STREET DEKALB CO. | LIGATURE STRANGULATION (3 PUNCTURE WOUNDS) | 17 | 125 LBS. | 5'4" |
| CATER | 5/21/81 | 3 | CHATTAHOOCHEE RIVER FULTON COUNTY | ASPHYXIATION/ STRANGULATION | 28 | 146 LBS. | 5'11" |

If so, an accurate estimation of the total amount of carpet produced or sold by a manufacturer in a particular area could be determined. This may not be an easy task, but is possible, as shown in the Williams case. It is assumed that each of the carpet manufacturers is using dye formulations unique to its company, for reasons explained earlier.

Refer again to figure 5. In addition to the two probability numbers already discussed (bedroom and station wagon carpets), each of the other fiber types linking Williams to both Cater and Payne has a probability of being found in a particular location. The chance of finding all of the fiber types indicated on the chart in one location (seven types on Payne's body and six types on Cater's body) would be extremely small. Although an actual probability number for those findings could not be determined, it is believed that the multiple fiber associations shown on this chart are proof that Williams is linked to the bodies of these two victims, even though each fiber match by itself does not show a positive association with Williams' environment.

Studies have been conducted in England that show that transferred fibers are usually lost rapidly as people go about their daily routine.[17] Therefore, the foreign fibers present on a person are most often from recent surroundings. The fibrous debris found on a murder victim reflects the body's more recent surroundings, especially important if the body was moved after the killing. Accordingly, the victims' bodies in this particular case are not only associated with Williams, but are apparently associated with Williams shortly before or after their deaths.

It was also pointed out during the trial that the locations of the fibers—on Payne's shorts and in Cater's head hairs and pubic hairs—were not those where one would expect to find fibrous debris transferred from an automobile or a house to victims who had been fully clothed.

Although from these findings it would appear that the victims were in the residence of Williams, there was one other location that contained many of the same fibers as those in the composition of various objects in his residence—Williams' station wagon. The environment of a family automobile might be expected to reflect, to some extent, fibers from objects located within the residence. This was true of the 1970 station wagon. With one exception, all of the fiber types removed from Payne and Cater, consistent with originating from items shown in the center of figure 5, were present in debris removed by vacuuming the station wagon. The automobile would be the most logical source of the foreign fibers found on both Payne and Cater if they were associated with Williams shortly before or after their deaths. It should also be pointed out that two objects, the bedspread and the blanket, were portable and could have at one time been present inside the station wagon.

Both Payne and Cater were recovered from the Chattahoochee River. Their bodies had been in the water for several days. Some of the fibers found on these victims were like fibers in the compositions of the bedroom carpet and bedspread except for color intensity. They appeared to have been bleached. By subjecting various known fibers to small amounts of Chattahoochee River water for different periods of time, it was found that bleaching did occur. This was especially true with the carpet and bedspread fibers from Williams' bedroom.

Two crime laboratory examiners testified during the closing stages of the first part of the trial about Wil-

liams' association with Payne and Cater. They concluded that it was highly unlikely that any environment other than that present in Wayne Williams' house and car could have resulted in the combination of fibers and hairs found on the victims and that it would be virtually impossible to have matched so many fibers found on Cater and Payne to items in Williams' house and car unless the victims were in contact with or in some way associated with the environment of Wayne Williams.

After testimony was presented concerning the Payne and Cater cases, the Fulton County District Attorney's Office asked the court to be allowed to introduce evidence in the cases of 10 other victims whose murders were similar in many respects. Georgia law allows evidence of another crime to be introduced " . . . if some logical connection can be shown between the two from which it can be said that proof of the one tends to establish the other as relevant to some fact other than general bad character." [18] There need be no conviction for the other crime in order for details about that crime to be admissible.

It was ruled that evidence concerning other murders could be introduced in an attempt to prove a "pattern or scheme" of killing that included the two murders with which Williams was charged. The additional evidence in these cases was to be used to help the jury ". . . decide whether Williams had committed the two murders with which he is charged." [19]

There were similarities between these additional victims and Payne and Cater. (See fig. 6.) Although some differences can also be seen on this chart, the prosecution considered these differences to fit within the "pattern of killing" of which Payne and Cater were a part. The most important similarities between these additional victims were the fiber matches that linked 9 of the 10 victims to Williams' environment. The fiber findings discussed during the trial and used to associate Williams to the 12 victims were illustrated during the trial. (See fig. 7.)

The 12 victims were listed in chronological order based on the dates their bodies were recovered. The time period covered by this chart, approximately 22 months, is from July

*Figure 7*

| NAME OF VICTIM | VIOLET AND GREEN BEDSPREAD WILLIAMS' BEDROOM | GREEN CARPET WILLIAMS' BEDROOM | DOG HAIRS WILLIAMS' DOG | YELLOW BLANKET WILLIAMS' BEDROOM | BLUE RAYON FIBERS DEBRIS FROM WILLIAMS' HOME | TRUNK LINER 1979 PLYMOUTH | CARPET 1970 FORD | CARPET 1979 CHEVROLET | ADDITIONAL ITEMS FROM WILLIAMS' HOME, AUTOMOBILES OR PERSON |
|---|---|---|---|---|---|---|---|---|---|
| **Alfred Evans** | X | X | X | | | X | | | |
| **Eric Middlebrooks** | X | | X | | | | X | | YELLOW NYLON<br>FORD TRUNK LINER |
| **Charles Stephens** | X | X | X | | X | | | | YELLOW NYLON WHITE POLYESTER<br>BACKROOM CARPET FORD TRUNK LINER |
| **Lubie Geter** | X | X | X | | | | | X | KITCHEN CARPET |
| **Terry Pue** | X | X | X | | | | | | WHITE POLYESTER<br>BACKROOM CARPET |
| **Patrick Baltazar** | X | X | X | X | | | | X | YELLOW NYLON WHITE POLYESTER HEAD HAIR<br>GLOVE JACKET PIGMENTED POLYPROPYLENE |
| **Joseph Bell** | X | | | | X | | | | |
| **Larry Rogers** | X | X | X | X | | | | X | YELLOW NYLON<br>PORCH BEDSPREAD |
| **John Porter** | X | X | X | X | X | | | X | PORCH BEDSPREAD |
| **Jimmy Payne** | X | X | X | X | X | | | X | BLUE THROW RUG |
| **William Barrett** | X | X | X | X | X | | | X | GLOVE |
| **Nathaniel Cater** | X | X | X | X | | | | | BACKROOM CARPET YELLOW-GREEN SYNTHETIC |
| | | | | | | | | | |

1979, until May 1981. During that time period, the Williams family had access to a large number of automobiles, including a number of rental cars. Three of these automobiles are listed at the top of figure 7. If one or more of the cars was in the possession of the Williams family at the time a victim was found to be missing, the space under that car(s) and after the particular victim's name is shaded.

Four objects (including the dog) from Williams' residence are listed horizontally across the top of figure 7, along with objects from three of his automobiles. An "X" on the chart indicates an apparent transfer of textile fibers from the listed object to a victim. Other objects from Williams' environment which were linked to various victims by an apparent fiber transfer are listed on the right side of the chart. Fiber types from objects (never actually located) that were matched to fiber types from one or more victims are also listed either at the top or on the right side of the chart. Fourteen specific objects and five fiber types (probably from five other objects) listed on this chart are linked to one or more of the victims. More than 28 different fiber types, along with the dog hairs, were used to link up to 19 objects from Williams' environment to 1 or more of the victims. Of the more than 28 fiber types from Williams' environment, 14 of these originated from a rug or carpet.

The combination of more than 28 different fiber types would not be considered so significant if they were primarily common fiber types. In fact, there is only 1 light green cotton fiber of the 28 that might be considered common. This cotton fiber was blended with acetate fibers in Williams' bedspread. Light green cotton fibers removed from many victims were not considered or compared unless they were physically intermingled with violet acetate fibers which were consistent with originating from the bedspread. It should be noted that a combination of cotton and acetate fibers blended together in a single textile material, as in the bedspread, is in itself uncommon.

The only other natural fiber of the 28 types discussed was a rust-colored woolen fiber removed from the body of Patrick Baltazar. This fiber was consistent with woolen fibers in the composition of a leather jacket recovered from Williams' home. Additionally, a rayon fiber of the type also present in this leather jacket was removed from Baltazar's body.

Some of the objects contained more than a single fiber type. Many of the different fiber types within each of these objects were recovered from at least one victim.

Williams was strongly linked to all the victims except Joseph Bell. Bell was a "river victim," whose body was recovered from the South River in Atlanta 31 days after he was reported missing. The body was recovered wearing only a pair of undershorts, and as would be expected, very few fibers were located.

The bodies of the nine victims were recovered near streets and highways in the Atlanta metropolitan area. It appeared that in all of these cases, the bodies had been moved from the murder scene to the recovery sites. A considerable amount of fibrous debris was recovered from these nine victims. As would be expected, the number of individual fibers within a fiber type linking any one of these victims to Williams' environment was much larger than in the cases of Payne and Cater.

The previous discussion concerning the significance of multiple fiber matches can be applied to the associations made in the cases of all the victims except Bell, but especially to the association of Patrick Baltazar to Williams' environment. Fibers and animal hairs consistent with having originated from 10 sources were removed from Baltazar's body. These 10 sources include the uncommon bedroom carpet and station wagon carpet. In addition to the fiber (and animal hair) linkage, two head hairs of Negroid origin were removed from Baltazar's body that were consistent with originating from the scalp area of Williams. Head hair matches were also very significant in linking Williams to Baltazar's body. In the opinion of author, the association based upon the hair and fiber analyses is a positive association.

Another important aspect of the fiber linkage between Williams and these victims is the correspondence between the fiber findings and the time periods during which Williams had access to the three automobiles listed on the chart. Nine victims are linked to automobiles used by the Williams family. When Williams did not have access to a particular car, no

fibers were recovered that were consistent with having originated from that automobile. Trunk liner fibers of the type used in the trunks of many late model Ford Motor Company automobiles were also recovered from the bodies of two victims.

One final point should be made concerning Williams' bedroom and station wagon carpets where probability numbers had been determined. Fibers consistent with having originated from both of these "unusual" carpets were recovered from Payne's body. Of the nine victims who were killed during the time period when Williams had access to the 1970 station wagon, fibers consistent with having originated from both the station wagon carpet and the bedroom carpet were recovered from six of these victims.

The apparent bleaching of several fibers removed from the bodies of Payne and Cater was consistent with having been caused by river water. Several fibers similar to those from Payne and Cater were removed from many of the victims whose bodies were recovered on land. Consistent with the bleaching argument, none of the fibers from the victims found on land showed any apparent bleaching. The finding of many of the same fiber types on the remaining victims, who were recovered from many different locations, refutes the possibility that Payne's and Cater's bodies picked up foreign fibers from the river.

The fact that many of the victims were involved with so many of the same fiber types, all of which linked the victims to Williams' environment, is the basis for arguing conclusively against these fibers originating from a source other than Williams' environment.

It is hoped that this article has provided valuable insight concerning the use of fiber evidence in a criminal trial, has provided answers to questions from those in the law enforcement community about textile fiber evidence in general, and has presented convincing arguments to establish Wayne Williams' association with the bodies of the murder victims. **FBI**

**Footnotes**

[1] *The National Law Journal*, vol. 3, No. 43, July 8, 1981, p. 1.

[2] *Man-made Fiber Fact Book Update: Statistics* (Man-made Fiber Producers Association, Inc., 1980).

[3] Ibid.

[4] L. C. Nickolls, "The Identification of Stains of Nonbiological Origin," *Methods of Forensic Sciences*, ed. Frank Lundquist, vol. 1. (N.Y.: Interscience Publishers) 1962, p. 335.

[5] To illustrate this point, assume that 200,000 automobiles were manufactured, each containing a carpet with a particular type of carpet fiber. These automobiles were then sold and distributed evenly throughout the United States. The population of the United States in 1980 was around 220 million. It could be argued that a metropolitan area in the United States with a population of 2,200,000 would have approximately 2,000 automobiles containing the carpet of interest. These 2,000 automobiles would be a very small percentage of all of the automobiles in that particular metropolitan area.

[6] This category would include silk fibers, cashmere fibers, nytril fibers, and aramid fibers, as well as other fiber types that are very expensive, which were never fully commercialized or are not used in common textile materials. These fiber types are rarely seen by crime laboratory examiners.

[7] *Encyclopaedia Britannica*, 15th ed., vol. 5, 1974, p. 1105; see also *The Analytical Chemistry of Synthetic Dyes*, ed. K. Venkataraman (N.Y.: John Wiley and Sons), p. 2.

[8] R. Cook and C. P. Wilson, "The Significance of Finding Extraneous Fibers in Contact Cases," Metropolitan Police Forensic Science Crime Laboratory, Report, No. 5 (1981). London, England.

[9] Max Frei-Sulzer, "Coloured Fibres in Criminal Investigations," *Methods of Forensic Science*, ed. A. S. Curry, vol. IV, 1965, p. 172, for a brief discussion of the evidential value of fiber evidence.

[10] C. A. Pounds, "The Recovery of Fibers from the Surface of Clothing for Forensic Examinations," *Journal of the Forensic Science Society*, vol. 15, 1975, p. 127.

[11] Prior to the publication of the February 11, 1981, newspaper article, one victim from the task force list, who was fully clothed, had been recovered from a river in the Atlanta area. In the 2½-month period after publication, the nude or nearly nude bodies of seven of the nine victims added to the task force list were recovered from rivers in the Atlanta area.

[12] E. J. Mitchell and Holland, "An Unusual Case of Identification of Transferred Fibers," *Journal of the Forensic Science Society*, vol. 19, 1979, p. 23. This article describes a case in which carpet fibers transferred to a murder victim's body in England were traced back to the carpet manufacturer and finally to an automobile owned by the person who eventually confessed to the murder.

[13] This information was taken from a study by E.I. du Pont de Nemours & Co. concerned with the existing residential floor space with carpet in the United States. This study was reported in the marketing survey conducted by the Marketing Corporation of America, Westport, Conn.

[14] Information regarding the number of housing units in the Atlanta metropolitan area was obtained from a report provided by the Atlanta Regional Commission. The report, dated November 11, 1981, contained population and housing counts for counties, super districts, and census tracts in the Atlanta metropolitan area.

[15] Information about carpet similar to Williams' carpet was developed through contacts with carpet manufacturers and carpet salesmen in Georgia. It was determined that this type carpet was often installed in commercial settings, such as apartments, and in those settings, had an average life span of 4 to 5 years.

[16] Joseph L. Peterson, ed. *Forensic Science* (New York: AMS Press, Inc., 1975), pp. 181-225. This collection of article[illegible]aling with various aspects of forensic science, co[illegible]s five papers concerned with using statistics to in[illegible]et the meaning of physical evidence. It is a good discussion of probability theory and reviews cases where probability theory has been used in trial situations.

[17] C. A. Pounds and K. W. Smalldon, "The Transfer of Fibers between Clothing Materials During Simulated Contacts and their Persistence During Wear," *Journal of the Forensic Science Society*, vol. 15, 1975, pp. 29-37.

[18] *Encyclopedia of Georgia Law*, vol. 11A (The Harrison Company, 1979), p. 70.

[19] *The Atlanta Constitution*, "Williams Jury Told of Other Slayings," Sec. 1-A, 1/26/82, p. 25.

1982, p. 25.

# MURDER STALKED THE EXECUTIVE SUITE

by JOSEPH L. KOENIG

SIXTEEN years old and fresh out of high school, Edward C. Stermer went to work for the Mudge Paper Company. Except for the war years, when Uncle Sam employed him as a flight instructor in York and Lancaster, Pennsylvania, it was the only job he ever had. And he was successful at it, too. When he was gunned down outside his South Baltimore, Maryland, office at 5:15 on the chill Thursday evening of December 16, 1976, he was the firm's president, a position he had held since 1960.

Less than 20 minutes after five slugs were pumped into his body from a 9-mm. automatic, the 62-year-old Stermer was at the emergency room door of University Hospital. It was already too late. Doctors had only to take a look at the handsome, gray-haird businessman to see that he was beyond the efforts of medical science. They pronounced him dead on arrival at 5:32 p.m.

At the crime scene on the 1400 block of Russell Street, meanwhile, homicide detectives recovered three spent shells evidently fired from the death weapon. While some investigators examined the victim's rented, 1974 Mercury in the Mudge parking lot, others grilled witnesses who told them that just before he was slain Stermer had left his office in the rear of the building to go to a company Christmas party at a nearby motel.

Business tycoon Edward Stermer was shot down outside his office, and police could find no apparent motive—until they began checking a certain person's stock holdings

"We spoke with a paper company employe who told us that he heard gunshots, looked out a window and saw Stermer lying face up on the sidewalk near the lot," a detective would report. "Some other workers rushed out of the building and found him bleeding heavily from chest wounds just two feet from the building.

"We also interviewed a passerby who said that at the time of the shooting he saw a man running down Russell Street. There were also some unconfirmed reports that the gunman was spotted getting into a Sun taxi, and we're trying to verify that right now."

In the first moments of the murder investigation, flak-jacketed officers from the Baltimore Police Department's Quick Response Team were sent into the area. Armed with high-powered shotguns, they combed a tunnel, running under Russell Street close to the shooting scene, but found nothing.

Other investigators reported better luck, coming up with a witness to the shooting in the person of Hassan R.

**For the paper company president, Baltimore detectives discovered, wealth and success became a mixed blessing—they got him killed**

**Probe suddenly focused on Charles Brent (l.) and Hassam Erman, comptroller-treasurer for Stermer's paper company, who was in line to take over the firm**

Erman, Mudge Paper's 53-year-old treasurer. Erman reportedly stated that he had left the office about two minutes before Stermer and was about a block away when he heard the shots and ran back toward the building.

"What did you see?" a detective had asked.

Hassan seemed apologetic as he replied that he had seen only "a shadow." He explained that he had glaucoma and was not wearing his glasses, so he was not even certain that the shadow was that of a person. When he left the office, he added, he had noticed nothing out of the ordinary.

In the homicide bureau at Baltimore police headquarters, that evening, detectives went over the meager evidence they had collected in the first few hours of the probe.

"It appears that Stermer had left the building and was walking toward the company parking lot when someone shot him five times in the chest," a detective said.

"Was it robbery?" a uniformed officer asked.

"That's what we thought at first," the detective answered. "Stermer was a rich man, with an income well into six figures. His wife told us that he usually cashed his paycheck on Thursday and carried between $100 and $200 in his wallet at all times. The wallet was gone, but the killer didn't trouble to go through his pockets, or take his keys, or lift an expensive camera he was wearing around his neck.

"Not only that, but minutes before Stermer left the building another company executive went out the same door. He was just as prosperous-looking as Stermer, but no one tried to rob or shoot him. From the evidence we have so far, it seems as though whoever shot Stermer was gunning for him."

"If robbery wasn't the motive," the uniformed officer asked, "what do you suppose it could be—a personal thing, a business rivalry, an enemy of long-standing?"

"It's too soon to tell," the detective replied. "But I can promise you we're going to find out."

In succeeding weeks and even years, the detective would learn that such a promise was much easier to make than to keep. Edward C. Stermer had been an unusually private man, and although the basic facts of his life were a matter of public record, it was not an easy task to delve beneath the surface.

It was no secret that the slain businessman had made his home in suburban Timonium, Maryland. A Baltimore native, he had graduated from high school in 1931 and gone to work immediately for Mudge. In the 1930s, he had opened the firm's York, Pennsylvania, office and after a stint as a World War II flight instructor had returned to his old job.

In 1960, he had been made president of the company. According to one close acquaintance he was a man with "a six-figure income, a successful man who was going to continue to be successful." His hobbies were golf and sailing.

But Stermer's business career was not without its setbacks. Perhaps its darkest hour had come just a month before his death, when, following plea-bargaining in state court, he had been fined $5,000 and his firm assessed $22,500 for allegedly substituting an inferior grade of paper than specified in contracts Mudge Paper Co. held with the city of Baltimore and state of Maryland. The charges to which Stermer had pleaded no contest indicated that he had been aware of an untrue statement in a $61,000 contract which his firm had signed with the state in March, 1976.

According to the statement of facts agreed to when Stermer and Mudge entered their pleas, the Mudge Company evidently was low bidder on city and state contracts by submitting a price for the specified top grade paper that was an average between top grade and the next lowest grade. But when deliveries were made the lower grade paper was substituted.

"Even though we went through our court problems a while ago," a company official said, "I still think most people in the industry hold us in high regard. Mr. Stermer was a smart, highly respected businessman."

"After the indictments came through, the people at Mudge were plenty embarrassed," an industry spokesman agreed. "They weren't crooks. It was just one of those things that sometimes happens. They were still highly regarded by their fellow tradesmen."

The next day, homicide investigators told newsmen that they had turned up disappointingly few clues in the murder case, but were eagerly awaiting the results of the autopsy on the victim.

"We still haven't determined the motive behind the killing," a detective said. "Right now, we're interested in speaking with anyone who was driving by the scene of the slaying about a quarter past five yesterday and we urge them to call the homicide department."

Later in the day, a medical examiner told police that fatal bullets had struck Edward Stermer in the heart, both lungs, the liver and stomach. Although the shots had been fired at such close range that powder burns were found on the victim's stomach, the report stated that the "chest wounds had the appearance of distant wounds."

The brutal slaying of Edward Stermer remained front page news for

*(Continued on page 58)*

## Murder Stalked Executive Suite

*(Continued from page 16)*

just two days before vanishing entirely from the Baltimore newspapers. This did not mean that it had been forgotten, as well, by homicide probérs. On the contrary, detectives were working relentlessly to come up with the badly needed clue that would solve the mystery. But their efforts remained a secret outside the department until February 21, 1977, when two sketches of the possible triggerman appeared below headlines that a $10,000 reward was being offered for information leading to his arrest and conviction.

The first drawing was that of a well-dressed, clean-shaven man in his mid-40s wearing a gray top coat and short-brimmed hat. He had been spotted by a truck driver who told detectives that he had noticed an "important-looking man" standing on the corner two blocks from the paper company's offices about an hour before the slaying. The driver explained that he had glanced twice at the man because he "looked strange" and out of place standing on the littered street while a black and white taxi was waiting nearby.

Lieutenant Arthur E. Westveer, the Baltimore homicide prober in charge of the case, said that the police artist's sketch was the only description his men had been able to obtain of someone who might have been hired to kill Stermer.

"If I were a hit man," he said, "I'd take a cab and pay a guy twenty bucks not to record where he took me," he said.

Although detectives had interviewed businessmen and construction workers in the area, he added, no one was able to explain why a man of such description would have been "hanging around." Neither had police been able to trace the cab.

The second drawing was that of a young man between the ages of 21 and 25 with long blond hair parted down the middle. He had been spotted by a night watchman at the construction site across the street as he tried to open the doors at the paper company on the night before and two days prior to the murder.

Lieutenant Westveer said his men believed the chances were "slim" that robbery had been behind the killing. He said the "execution-type" murder indicated that Stermer was slain by someone who knew whom he was after, knew how to kill and wanted his victim dead.

Westveer refused to completely rule out robbery as a motive, but insisted that three facts leaned toward the professional killing theory. The first, he said, was that Hassan Erman, the treasurer of Mudge Paper, who was well-dressed and as likely a target for a robbery as Stermer, had left the building only minutes before the doomed executive, yet he was not attacked. The second was that the 9 mm. automatic believed to be the death weapon was a sophisticated gun, costing about $200, which a common bandit would not buy for a robbery. The final fact was that Stermer's pockets were not rifled by the slayer and that his valuable camera was left hanging from his neck.

Since both gun and Stermer's wallet were missing, the lieutenant went on, detectives were being hindered in their efforts. In fact, his men had not even been able to prove that Stermer was carrying his wallet the day he was shot. Reportedly they had spoken with a man who had lunched with the businessman three hours before the shooting and who told them that Stermer had paid the check with money he took from his pocket, rather than the wallet he normally carried.

Lt. Westveer said that although detectives had questioned at least 300 persons who knew the victim and also had probed every facet of his private life,

they had yet to find a single person who did not like Edward Stermer.

"He had so many friends and so many people liked the guy," Westveer said. "It's nice to hear he was a nice guy, but it's depressing. We want to find someone who didn't like him enough to kill him."

Another stumbling block, he pointed out, was the lack of a detailed description of the gunman.

"Whoever shot him could have disappeared in a matter of seconds," he said. The most likely escape route, probers agreed, would have been through the poorly lighted construction area near the death scene.

Detectives long ago had concluded it was highly improbable Stermer's legal problems had had anything to do with his death. Late in December they had spoken with one of his sons who told them that his father had decided to appeal for a reduction in the penalties, particularly a year-long prohibition on bidding for city and state contracts, "because he was convinced he hadn't done anything wrong."

The victim's widow had said that one of the reasons her late husband had pleaded no contest to the charges was that if he had fought the case "a lot of city and state people could lose their jobs.

" 'A lot of people could lose a lot of things,' " she quoted him as having said. " 'Why do I have to plead no contest to a lie?' "

"I know my husband wanted to clear his name," the distraught woman told investigators.

In the days immediately preceding his death, she added, Edward Stermer had been making the rounds of city and state agencies that were his long-time customers "as the first step in his appeal bid."

His son explained that prior to entering the no contest plea, Stermer had been led by prosecutors to believe that legal costs and possible maximum fines, in the event of conviction, could bankrupt the 141-year-old paper company. He said that his father was worried about financial hardship, not only for himself, but for all the firm's employes.

Before the indictment was made public on October 28, 1976, he went on, his father already had told the family that charges were pending. He also had explained how substitute products sometimes were furnished to city and state agencies in a sort of "gentleman's agreement."

His father told him that a city or state purchasing employe might forget to record a transaction, promptly or else might need in a hurry a certain grade of paper which Mudge did not have in stock. In such a case, Stermer said, the firm often was told:

"Send us what you've got."

"It was a matter of deadlines, not fraud," the younger Stermer said.

In criminal court, defense counsel had explained that Mudge occasionally lost money in handling such emergencies, but he was willing to do so to protect the company's reputation for speedy delivery. Of the $469,000 in sales involved in the charges, only $5,300 could be counted as profit to the company, Stermer's son said.

The victim's widow recalled that she and her husband had gone over the company's records for substitutions of higher rather than lower quality paper and found the $5,300 figure reduced to "$1,600 or $1,800."

Homicide detectives told newsmen that they had been unable to link Stermer's death to the criminal charges. Lieutenant Westveer said they had found that the person who tipped off the state's attorney's office to questionable business practices by the paper firm was not involved in the killing. However, Westveer did acknowledge that the scandal had distressed Stermer.

"He was very proud of his company, and it hurt him," he said. "Morally, he felt he didn't do anything wrong."

Stermer evidently had good reason to feel that way. An executive of the com-

pany told reporters that Mudge Paper "is still functioning as it did before the killing because of the way he set up the company." He added that the firm and its remaining stockholders were in the process of purchasing the 51 per cent of the Mudge stock held by the Stermer estate.

The public's response to publication of the sketches of the suspects was a bitter disappointment to the homicide investigators. When the trickle of leads dried up altogether, they had no choice but to turn their attention to newer, more pressing cases. This time, when the Stermer murder faded from the newspapers it did not return for nearly two years. But police never forgot the case nd periodically reviewed the files the hope of finding some crucial clue they had overlooked.

In June of 1978, a Maryland state police undercover agent assigned to the contract murder squad elicited from one of his informants a few details concerning an "unsolved murder in South Baltimore." Certain that they would be interested in what he had found out, the trooper called his colleagues on the Baltimore Police Department and passed along the few leads he had uncovered. The city homicide probers were able to fit the new information into the partially developed picture of the Stermer case.

Because the state policeman had received his information third-hand, a city police source would report, Baltimore detectives had to work back to the source of the details. In time, they completed gathering their facts and late in the autumn they took their information to the state's attorney. After examining it carefully, he presented it to a grand jury.

As a result, on Friday, December 15, Baltimore homicide detectives obtained a warrant charging 27-year-old Charles E. Brent of Brookbury Drive in Reisterstown, Maryland, a community of 13,000 in Baltimore's northwest suburbs, with murder, armed robbery and handgun violations stemming from the murder of Edward C. Stermer. As soon as they were in possession of the long-awaited document, police went looking for the suspect, who also went under the name of Anthony Edward Perro.

Detectives Bryn Joyce and Benjamin Brannock of the state's attorney's office were unable to find him, and the assumption was that he had fled the state. Almost at once, Lieutenant Westveer issued a photograph of the wanted man to the news media.

Howard Gersh, head of the violent crimes unit of the state's attorney's office, and his assistant, Peter Semel, told reporters that they would not discuss any aspect of the probe. However, newsmen already had learned that while the police investigation was proceeding, the grand jury had spent abou a month listening to witnesses who were acquainted with various aspects of the case. Reportedly, the investigative panel was seeking accomplices in the killing.

Newsmen believed that much of the renewed work on the case had come as the result of the impending expiration of the statute of limitations on some of the charges. Because the investigation had lasted for nearly two years, reporters felt that it would have to be brought to a halt in the near future, perhaps as soon as the next week.

Three days later, on Monday, December 18, 1978, employes of the Mudge Pape Company were stunned to learn that 5 year-old Hassan R. Erman, the firm's comptroller-treasurer, had been charged with arranging the murder-for-hire of Edward Stermer. Erman, who made his home on Garrison Forest Road in Owings Mills, Maryland, was taken into custody at his Russell Street office about 10:30 that morning on charges of first degree murder, assault, robbery and handgun violations.

One source close to the probe said that Erman was believed to have arranged Stermer's slaying purely for financial gain. Under an agreement, he noted, the stock of a deceased Mudge official was to be retired, and because there would then be fewer shares of outstanding stock, the value of all the remaining shares would increase. At the time of his death, Stermer was believed to have owned some 51 per cent of company stock.

Hassan R. Erman, newsmen learned, was a University of Baltimore graduate who had received his MBA degree from Loyola College in 1976. A Turkish native of the troubled island nation of Cyprus, Erman had been a Mudge employe for about 20 years. Hired as comptroller, he also had become a vice president in 1972 and reportedly owned about five per cent of the company's stock when Stermer died.

Booked on the charges on Monday afternoon, Erman was freed from custody that evening after posting bond of $150,000.

The hunt for Charles E. Brent continued until Friday, December 22nd, when the accused triggerman was arrested in California and jailed pending an extradition request from Maryland. That same day, a Baltimore grand jury indicted him on charges of murder, robbery and conspiracy in the Stermer case and cited Hassan Erman on charges of murder, robbery, conspiracy and accessory before the fact of murder.

Questioned by newsmen about the details of Brent's arrest, Baltimore State's Attorney William A. Swisher said that the exact location where the suspect was being held would not be revealed pending further investigation into the murder. According to Assistant State's Attorney Semel, the probe was still underway and additional matters might be taken before the grand jury. It was reported that police still were eager to develop information about the missing death weapon.

At a pre-trial hearing on Friday, May 18, 1979, Assistant State's Attorney Harvey E. Greenberg said that Erman and Brent attempted to "cover up" their involvement in the case by lying to the

police for over a year, and that because the conspiracy continued for so long after the slaying, the charges were not subject to the one-year limitation on conspiracy. Greenberg went on to say that he would show, at the trial, that after Stermer was dead the defendants schemed to stalk and kill another officer of the paper company.

Prosecutor Greenberg said that the state would produce evidence showing that in 1977 and 1978 Charles Brent voluntarily made statements to Anne Arundel County and Baltimore police that were "false and misleading." There was a total of seven statements, he added, all of which was an effort to conceal the nature of the conspiracy and show that Hassan Erman was the intended victim of a scheme.

An attorney for Brent, who had been lodged in the Baltimore City Jail upon his return to Maryland, said that he was withdrawing a plea of not guilty by reason of insanity for his client and entering, instead, a general plea of innocent. Brent, it was noted, had been found competent to stand trial on the charges following mental examinations, in April, in Clifton T. Perkins State Hospital.

Four months later, at a Monday, September 24th, suppression of evidence hearing, Judge Marshall A. Levin barred press and public from his courtroom at the request of defense attorneys. State prosecutors offered no objection to the ruling. It was reported, nevertheless, that the matter under consideration by the court was the extent of Hassan Erman's financial involvement with Mudge Paper and whether or not the details of his holdings were to be excluded from trial testimony.

The murder trial got underway in the first week of October in Judge Levin's Baltimore Criminal Courtroom. In his opening remarks to the jury, Prosecutor Greenberg said that in addition to the murder of Edward Stermer, Hassan Erman had plotted the death of a vice-president of Mudge Paper as part of his plan to take over the company. At Erman's urging, he said, Charles Brent stalked the executive druing a 1976 business trip to West Virginia, but the plan fizzled when the driver Brent had enlisted to help him became sick and "chickened out." Brent, he said, "worshipped, adored and was linked" to Erman, and was even wearing some of his clothes at the time of his arrest in California.

On Thursday, October 11th, the state called to the stand a friend of Charles Brent who testified that the suspected hit man had told her that he was going to do a "big job" that would make him wealthy "around Christmas time" in 1976.

"'When I get all these jobs done,'" she quoted him as having said, "'I'll never have to worry about money again.'"

On another occasion, the woman said, her daughter "had a broken heart" and to cheer her up Brent brought her to Hassan Erman's house on Owings Mills to play tennis.

On Monday, October 15th, a Mudge Paper clerk told the court that Hassan Erman "surprised" the office staff on the afternoon of the slaying by allowing everyone to go home early.

Mudge Paper's secretary, the next day, testified that if both Edward Stermer and the firm's vice-president had died, the value of Hassan Erman's company stock would have increased almost tenfold, from $47,700 to $462,900. The company, the witness said, planned to use the proceeds from a life insurance policy taken out on Stermer to buy back and then retire his 51 per cent of the stock and the 35 per cent controlled by the vice-president.

On Wednesday, one of the three directors of the company at the time of the murder said that Hassan Erman would have been "best qualified" to take over Mudge Paper if both its top officers died. He added that earlier in 1976 Erman had recommended that the company buy an increased amount of insurance on Stermer's life, so that they would be in a position to redeem his stock in the event of his death.

On Thursday, October 18th, a senior clerk at the Baltimore Gas & Electric Company told the jury that in 1975 Erman had fallen so far behind in his payments that he owed the utility more than $1,300. A Baltimore Federal Savings and Loan Association officer said that in 1975 and 1976, Erman paid late charges on 16 occasions when mortgage payments fell due on his home.

On Monday, October 22nd, a 26-year-old Reisterstown, Maryland, man testified that Charles Brent had paid him to drive his truck to and from the Mudge offices on Russell Street on the day of the slaying. Although he heard gunfire, he said, he did not actually witness the murder. Later, however, Brent reportedly told him that he had slain Edward Stermer.

On Wednesday, a former roommate of Brent's told the court that a week before the slaying the defendant asked his advice on how he would go about killing a "man in his sixties." The witness said he had told Brent he would shoot him in the torso, that "if he's in his sixties it probably wouldn't take much to kill him."

Taking the stand in his own defense on Friday, November 2nd, Brent admitted talking about killing Edward Stermer, but he denied having anything to do with his death or with suggesting that Mudge Paper's vice-president be slain. He told the court that it was the Reisterstown man who had testified

earlier who actually was the triggerman.

Back on the witness stand on Monday, November 5th, Brent said that he had expected to collect $20,000 for "working out the details" of the murder of Mudge Paper's two top executives at Hassan Erman's urging. However, because things "kept getting screwed up," he said, he "called the whole thing off" and Erman never gave him any part of his fee. He was shocked, he said, to learn that Stermer had been murdered anyway.

Following the slaying, he said, the real killer harassed him for money and demanded that he speak with the detectives probing the murder.

" 'Go down there and get the police off my back,' " he quoted the man as saying.

In his closing arguments to the jury on Thursday, November 15th, Charles Brent's attorney said that his client was a "little silly and acted like a squirrel, but he just didn't have the guts" to kill Edward Stermer.

Hassan Erman's lawyer told the panel that his client "does not even belong" in court. Erman, he said, did not take the stand in his own defense because he did not need to and because Brent trapped himself in "lies" as he tried to implicate his client.

The attorney went on to say that the trial was "all about Mr. Brent," who was "trying to protect himself" when he made statements implicating his client while the police were "closing in on him" (Brent). He added that Brent was also trying to obtain the "$10,000 reward" offered for a solution to the case and that when the police failed to believe some of his stories he went further and talked about "contract murders."

"There were no conversations and therefore no contact between Mr. Erman and Mr. Brent," the attorney said.

Another defense attorney said that the jury should acquit Erman because he was a family man, a hard-working businessman who had started out in life as a poor immigrant from Cyprus.

On Wednesday, November 14, Prosecutor Greenberg had told the jury that "there is an in exorable connection between Mr. Brent and Mr. Erman" and that Brent "had the motive, opportunity and means to pull the trigger." Erman, he charged, was a man earning $30,000 who was trying to keep up with the lifestyle of his firm's $200,000-a-year salesmen.

The prosecutor went on to tell the jury that Erman had furnished Brent with the license number and West Virginia itinerary Of Mudge Paper's vice-president. When Erman heard that Brent had failed to kill the vice-president, he said, he brought Brent to a Morton Street, Baltimore, apartment used by Stermer, so that he could murder the company president there. The plan failed, he said, when Brent evidently was bitten by a rat while waiting in ambush for Stermer and Erman had urged him to try again, on Russell Street, on December 16, 1976.

After three hours of deliberation on Friday, November 16th, the Baltimore Criminal Court jury returned guilty verdicts against both men. Judge Levin set sentencing for December 20th, unless new trials were granted. ♦♦♦

END

12/11/90